Arid Lands Biodiversity in North Africa

Proceedings of the Workshop on Arid Lands Biodiversity in North Africa
14-16 November 1994, Cairo, Egypt

Edited by K.H.Batanouny and S.I.Ghabbour

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FOREWORD

The Workshop on Arid Lands Biodiversity (Cairo 14-18 November 1995) hosted by the Egyptian National Committee for IUCN was a welcome initiative. It provided a forum for concerned scientists from countries comprising a belt extending from the Atlantic across North Africa and the Red Sea to the Arabian Peninsula and its adjoining Middle East. This broad belt represents a biogeographical region with particularly interesting attributes: (i) arid climate prevails, (ii) physiographic features (coastal lands, mountain ranges, depressions with oases, extensive bodies of sand, etc.) provide for diverse habitat types, (iii) long history of human impacts of settled societies and nomadic groups. It lies in the transition between the Holarctic in the north and the Paleotropic in the south, and hosts biotic elements of both.

The cultural life of the peoples of this region throughout millennia has been closely knit with nature and its biota. Wild plants and animals provided reserves of food in lean years, medicine for many ailments, materials for cottage industries, etc. Traditional prose and poetry are rich in names of animals and plants, many of which have unfortunately disappeared.

The publication of the proceedings of the Workshop is most welcome as it provides a valuable source of information on biodiversity surveys and conservation programmes in several of the countries in a region extending from Morocco in the west to Saudi Arabia in the east. Organizers of the Workshop and editors of this volume deserve our gratitude and appreciation.

M. KASSAS
FORMER PRESIDENT OF IUCN

PREFACE

North Africa's arid lands constitute one of the most arid areas in the world. Because of this, it plays an essential role in the whole socio-economic development of biodiversity and sustainable development. Demands from increased agricultural, urban and industrial activities are also closely linked with the continued expansion of arid lands. In order to respond the needs of rapidly expanding arid lands, it is essential that the governments and concerned institutions such as IUCN take appropriate measures such as biodiversity strategy and action plans to be drawn up and implemented. As the need to implement strategies for sustainable development has now been widely recognized so has the necessity to undertake a thorough review of the regions' arid lands programme.

The first workshop on this subject held in Egypt in November 1994 is the sign of IUCN members and partners' concern in important matter. It was good to note that both scientific and technical issues as well as more importantly on socio-economic and administrative aspects of biological diversity management was discussed at the workshop. The discussion on the necessity to work on an inventory of biodiversity plants is also an important subject. As well, diffusions of information, education and awareness programme are also equally considered essential for a concerted programme. The focus on how to combat desertification and for restoration of ecosystem that have been desertified is also urgent. It is good to note that the workshop had the possibility to link between the desertification control and Convention on Biological Diversity conservation.

By publishing this first book on this subject by IUCN members in the region, IUCN-the World Conservation Union, with technical support from many national and regional institutions and members and partners aiming at increasing the awareness among decision makers and planners of the consequences of arid land degradation. It aims also to impress on them the need for renewed efforts to achieve a more sustainable use of biodiversity. It is hoped that this publication represents an important step towards the improved arid land programme for the region. In addition all those who have contributed to the publication that will be used at national and regional levels to identify the most important partners responsible for arid lands and thereafter for the design and implementation of national and regional arid land biodiversity conservation programme.

It is expected that the publication will help responsible authorities to identify the problem issues more clearly on the point of view of IUCN and its members perspectives.

I am confident that this book will contribute to understand better the status of arid lands and to ensure a wiser use of arid lands biodiversity in the North Africa and other adjacent countries in the region there.

DAVID MCDOWELL
DIRECTOR-GENERAL
IUCN

INTRODUCTION

The Egyptian National Committee for the Conservation of Nature and Natural Resources was established in 1972 within the Academy of Scientific Research and Technology to coordinate national activities related to this field, and with the International Union for Conservation of Nature and Natural Resources, based in Switzerland. The activities of the National Committee since its establishment were the main driving force which led to the promulgation of Law 102/ 1983 for the creation of natural protected areas in Egypt, which are now 16. The Committee's activities also led to the creation of the Authority of Wildlife Conservation within the Ministry of Agriculture, based in the Giza Zoological gardens, and later, the Egyptian Environmental Affairs Agency (EEAA), affiliated to the Council of Ministers, and under the supervision of the Minister of Administrative Development. These were the main achievements of the Committee in the 1970's and the 1980's, under the leadership of its first President, Professor M. Kassas, who had also been President of IUCN in the period 1978 - 1984.

In the 1990's, the Committee did not wish to rest on its laurels. It decided to expand its connections at the regional and the international levels, after having well prepared the ground at the national level. Talks with sister Arab countries, and with IUCN, showed that the desire for regional cooperation was shared by sister committees. In order to facilitate communication and exchange of information, several workshops were held for the five North African countries, of which the one on Biodiversity in Arid Lands of North Africa, was held in Cairo in the period 14 to 16 November 1994, under the auspices of the Egyptian National Committee.

The National Committee and the Editors are pleased to acknowledge with thanks and appreciation the support given to the Committee for holding the workshop and for the publication of the Proceedings, received from the Swiss Development Cooperation (Swiss Government) and from IUCN. We would like particularly to thank Mr. F. Parakatil, Regional IUCN Coordinator for West Asia and North Africa, whose efforts were instrumental in providing effective networking throughout the region. We would like also to thank the Academy of Scientific Research and Technology, and its personnel, who spared no effort to make the workshop a successful scientific event and to produce the Proceedings.

The present volume is the outcome of that workshop. It begins with the keynote speech by Prof. M. Kassas on the application of Agenda 21 for North African countries and a preface by Mr. D. Mc Dowell, Director General, IUCN. There are followed by three national papers from Morocco, Algeria, and Egypt, on the status of biodiversity in these countries, and measures taken to conserve it. The next part is made up of scientific communications presented by scientists from the five N. African countries, in addition to a number of Mashrek Arab countries, on various aspects of particular components of their flora and fauna. The last three papers in this section treat practical measures related to gene banks and to medicinal plants. This scientific part is followed by the report and recommendations of the workshop, for action to be taken up by governments and scientists, and the list of

participants. The Arabic section contains one paper on national projects to combat desertification in Tunisia, and a small lexicon of terms used in biodiversity literature, prepared and proposed by Dr Haddane of Morocco. In addition, there are two presentations by delegates from IUCN on the Sahel experience, and on the combat of desertification.

We hope that this volume will not only allow our colleagues to know about biodiversity and its problems in North African countries, but will also set forth action for its conservation and for its rational and sustainable utilization, in accordance with the principles outlined in the International Conventions.

The Editors

PROF. K.H. BATANOUNY,
CAIRO UNIVERSITY, PRESIDENT OF
THE EGYPTIAN NATIONAL COMMITTEE
FOR CONSERVATION OF NATURE AND
NATURAL RESOURCES

PROF. S.I. GHABBOUR,
CAIRO UNIVERSITY.
RAPPORTEUR, THE EGYPTIAN
NATIONAL COMMITTEE FOR CONSERVATION
OF NATURE AND NATURAL RESOURCES

CAIRO, SEPTEMBER 1996

Background Document For The Workshop

by
K. H. BATANOUNY
President, IUCN National Committee
Academy of Scientific Research and Technology, Egypt
Chairman of the Workshop

Introduction

The North African countries are a part of the arid belt extending from the Atlantic to central Asia. Aridity and the geographical location of these countries have a prominent effect on their biological elements.

Scientists, institutions and organizations, looking through a global lens, focus on biodiversity loss in tropical countries and give priority to what is called "hot spots". However, North Africa and the Middle East have numbers of plants and animals that rival the tropics in importance.

The region is the home of the wild relatives of many food crops, medicinal plants and feed for animals.

The region supported some of the oldest civilizations in the world, depending on the region's biodiversity for agriculture and pastoralism. It has a long history of intense human occupation, only limited relicts of its original life remain. A variety of biotic elements have disappeared or at the brink of disappearance. The biological diversity is continuously deteriorating in view of the population explosion, modernization, and innumerable human activities using improper technologies. One should consider the loss of say 10 species from the flora or the fauna of the desert ecosystem is relatively drastic and considerable as compared to the biomes with greater species richness.

The worldwide geographical regions meet here together. This makes the area of special interest and raises many problems as to the past history of the respective floras and faunas, their advances, their centres of distribution and speciation. The North African countries represent a transition from the Mediterranean climate to the Saharan one. This has a remarkable impact on the biodiversity and its distribution along a climatic gradient from north to south.

One of the most impressive characteristics of the region is the presence of isolated sites, which represent enclaves for special rare and endemic plants and animals. The fascinating isolated fauna on mountain islands in the Sahara are remnants of a wetter period. These refugial sites could be considered hot sites for the study and conservation of biological diversity.

The occurrence of long shores with vast coastal land, the oases in the Sahara, the innumerable landforms in the desert create a considerable habitat diversity with remarkable biodiversity.

The region was producing countless numbers of varieties and strains of different vegetables. With the advent of the Green Revolution which promoted the use of a limited number of high yielding varieties, innumerable local varieties that had been adapted to the harsh environments of the region were lost.

The great surge of public interest in the use of plants and animal products as medicine has been going on since times immemorial. The result is the loss of many plant and animal species. Consequently, the indigenous knowledge of the healers is lost.

It is a well known fact that the region supported for mellinia grazing herds of camels, sheep and goats led by hardy pastoralists. The overgrazing and other human activities caused the severe deterioration of the rangeland and the almost disappearance of numerous range plants.

Justification of the Workshop

1. Lack of knowledge

As evident from the introduction, the region's biodiversity is subjected to severe deterioration. The present status of our knowledge of biodiversity in the region at its three levels (gene, species and ecosystem) is not sufficient to help either making use of biodiversity or conserving it.

2. Hot sites

The region comprises hot sites of great importance including:

a• The mountion "islands" in the Sahara with their fascinating isolated fauna and flora. These are remnants of a wetter period.

b• Oases in the Sahara have their cheracteristic biodiversity which is threatened by the human impact.

c• The biota of the Nile region is subjected to pollution and deterioration. Also the man-made High Dam lak could be affected by pollution.

d• The enclaves in the mountains in the region are sites of endemic biota.

3. The Mediterranean Sea

The North African countries share with European and some Asian countries in the Mediterranean Basin. Factors affecting biodiversity of the marine ecosystem in any country are of widespread effect on the biodiversity of the other countries. There is a great need of cooperation among these countries.

4. Endemism

The region is rich in endemic biota which are adapted to the harsh desert conditions. They represent an asset of genetic resources which is rarely met elsewhere.

5. Relatives of cultivated plants

Relatives of some cultivated plants, either cereals, pulses or forage plants, are growing wild in the region. Being subject to extinction, there is a great need to conserve these plants. This could be achieved through identification, studies of their habitats, investigation of conservation measures, etc.

6. Lack of cooperation

The political will of the countries of the region is clear from signing and ratifying the different conventions on the conservation of nature and natural resources as well as that on biodiversity in Rio de Jeniero, 1992.

However, methodology of implementing the strategies needs to be adopted. The present workshop and the future ones will be helping the parties to formulate regional programmes for the study and conservation of biodiversity, especially in the arid lands. It is to be noted that other countries, other than the North African, as some Arab countries or central Asian ones have the same problems as regards biodiversity in the arid zones. This would encourage inviting participants from these countries, especially the members of the IUCN.

7. Native language

The North African countries have the Arabic language as the official one. However, the terms used in biodiversity, conservation, etc. are not well translated. This represents an obstacle to the mass media personnel. They are unable to disseminate knowledge to the public. This is a defect which must be repaired by preparing simplified books, brochures, etc. about the biodiversity and conservation issues in the native language. This helps decision makers to be acquainted with the problems.

8. Legislation

Signing and ratifying any convention is not enough to implement it within the country. There is a great need to put mechanisms for the enforcement of the law in every country in order to put the issues of the convention in action. The participants may cooperate to find measures to put the conventions into reality.

Objectives

1. Assessment of the present status of biodiversity and conservation in the arid zone of North Africa and the adjacent territories.
2. Investigating the national policies in the field of biodiversity and conservation of the region.
3. Identifying the gaps of knowledge in the field of biodiversity in arid zones.
4. Formulating programmes for cooperation among the countries in the field of conservation and the sustainable use of biodiversity in the arid zone. There may be short term and long term programmes, bilateral or multilateral, European - African, etc.
5. Discussing the measurs and means to encourage and facilitate cooperation among the countries of the region through exchange of information, networking, exchange of experts, data banks, preparation of directories, etc.
6. Investigating the possibility of establishing a regional office for the IUCN in North Africa.
7. Discussing the activities in the different countries related to Agenda 21.

Workplan

Outlines of the scientific programme

1. Plenary lecture on biodiversity in the arid zone of the Arab countries: problems and prospects.
2. Country reports: present status of biodiversity concerning programmes for its study and conservation. Assessment of gaps and needs for further studies and joint programmes.
3. Invited lectures on:
   - Habitat diversity in arid zones with special reference to enclaves and critical hot sites.
   - Agenda 21 and biodiversity in the Arab countries.
   - Agricultural development, tourism, and desertification and biodiversity.
   - Germplasm and conservation of biodiversity.
   - Endemic plants and animals in the region.
   - Medicinal plants in the region.

Output

1. National reports from the different participating countries.
2. Invited papers on different issues of biodiversity, its sustainable use, its economic value and conservation in the different countries.
3. Invited papers on human activities (tourism, agricultural development, etc.) and biodiversity.
4. Short-term programmes, e.g. writing books - brochures in Arabic language on biodiversity and conservation, joint regional programmes implementing the role of mass media and public awareness.
5. Long-term projects, studies of refugial sites in the different countries.
6. Regional and multilateral cooperation in the field of supporting referral collections and germplasm conservation.

PROGRAMME
ARID LANDS BIODIVERSITY WORKSHOP
Cairo, 14-16 November, 1994

14 November	
Oh900 - 09h30	Registration
09h30 - 10h30	Opening Session
10h30 - 11h00	Coffee Break
11h00 - 11h45	**Plenary Lecture** Two Elements of an Agenda 21 for North Africa **M. Kassas**, Egypt
11h45 - 13h15	**First Session** - Protected Areas and conservation of desert ecosystems **A.AL. Johany,** Saudi Arabia. - Desertification and Biodiversity in Arid Lands: Sahel experience. **S. Zeba,** IUCN Terrestrial Vertebrates in the Arid Lands of North Africa **M.Saleh,** Egypt
13h15 - 14h45	Lunch
14h45 - 16h15	**Second Session** - Soil Fauna Diversity in Arid Lands of North Africa **S. I. Ghabbour,** Egypt - Arid Land Fauna in N. Africa: Actual Situation and Perspective in the Future **B. Haddane,** Morocco - Medicinal Plants in North Africa: An Endangered Component of Biodiversity. **K.H. Batanouny,** Egypt.
16h15 - 16h45	Coffee Break.
16h45 - 18h15	**Third Session** - Useful Plants in North Africa and Arabia **L. Boulos,** Kuwait, Egypt - Genetic Resources in the Flora of Arid and Semi-Arid Lands. **Y. Barkoudah,** Syria - Concluding remarks and comments by different participants.
15 November	
09h00 - 11h00	**Fourth Session** - Germplasm Resources and Conservation of Biodiversity in North Africa **A. Zein El Abedin,** Egypt - Gene Banks: Right Approaches for the Achievement of the Goals.

	A. Abuzeid, Egypt - Sustainable Development and Arid Land Biodiversity in the Arab World. **A. Abufayed,** Libya - Habitat Diversity in Dry Lands. **Alia Hatough,** Jordan
11h00 - 11h30	Coffee Break.
11h30 - 13h30	**Fifth Session** Country Reports - Morocco **B. Haddane** - Algeria **Z. Sekkal** - Tunisia **J. Zemzemi** - Libya **A. Abufayed** - Egypt **E. El Badry** Present status of arid lands biodiversity, studies and research, running programmes, assessment of gaps and need for further studies and joint programmes.
13h30 - 14h30	Lunch
14h30 - 15h30	**Sixth Session** - A Model Arid Lands Case Study **N. Nasr,** Tunisia - Regional-International Programme for Flora and Fauna: IUCN Experience. **S. Linington,** IUCN Desertification Convention Relevant to Biodiversity Convention. **G. de Kalbermatten,** INCD Switzerland
15h30 - 18h30	**Seventh Session** Roundtable discussion for the formulation of a regional arid lands biodiversity programme.
16h30 - 17h00	Coffee Break.
17h00 - 18h30	Continuation of the seventh session.
16 November	
09h00 - 11h00	**Working groups.** - Plan for regional conservation - Coordination - Networking. - Short-long term programmes - Priority Areas of Action.
11h00 - 11h30	Coffee Break.
11h30 - 12h30	Working groups - Preparation of the Recommendations.
12h00 - 13h00	**Closing Session.**
13h00 - 14h00	Lunch.
14h00	Visit to the Pyramids & Sakkara.

Two Elements of an Agenda 21 for North Africa

By
M. KASSAS
Faculty of Science
University of Cairo

Introduction

The world community assembled in Rio de Janeiro, Brazil (3-14 June 1992); the United Nations Conference on Environment and Development (Earth Summit). This was 20 years since the UN Conference on the Human Environment held in Stockholm, Sweden (5-16 June 1972). In 1972 the world community seemed concerned with impacts of environmental hazards and degradation (pollution) on the well being of humankind. In 1992 the world community seemed concerned with prospects and challenges of development that would be sustainable, and seemed convinced that global partnership was imperative. This concern led to the adoption of a comprehensive programme of action to be implemented - within the framework of global partnership - during the few years that remained in this century and throughout the next century: Agenda 21. The programme addressed all actors: governments of developed and developing countries, public and private sectors, UN bodies, financial institutions, non-governmental organizations, etc. Because the programme addressed all aspects of environment and development, and all actors concerned, it ran into 40 chapters and its text seemed voluminous. But when we note that policies, attitudes and courses of action need to be changed and when we note the issue at stake is survival of humankind, then we would understand the need for the detailed presentation.

At Rio de Janeiro the world was ready to adopt two international conventions: one on climate change and one on biodiversity, was ready to adopt a statement of principles related to management, conservation and sustainable development of forests, and to set the stage for negotiating an international convention on desertification. The latter was duly negotiated and was open for signature in October 1994. All these instruments indicate the readiness of the world community to work together in addressing the issues of global concern, and to translate the words into deeds.

Agenda 21

Apart from a brief preamble, Agenda 21 comprises four sections. The first (social and economic dimensions) includes chapters 2-8: sustainable development in developing countries, changing consumption patterns, demographic dynamics, human health, human settlement, integrating environment and development in decision making.

The second section (conservation and management of resources for development) includes chapters 9-22: the atmosphere, planning and management of land resources, deforestation, desertification and drought, fragile ecosystems including mountains, agriculture and rural development, biological diversity, biotechnology, oceans and seas, freshwater resources, toxic chemicals, hazardous wastes, solid wastes and sewage, radioactive wastes. This section covers substantial elements of sustainable development of resources and of combating hazardous degradation of the environment.

The third section (strengthening the role of major groups) includes chapters 23-32: women children and youth, indigenous people and their communities, non-governmental organizations, local

authorities, workers and trade unions, business and industry, scientific and technological community, farmers. In these chapters the roles of theses groups are identified and means are set for enabling each group to play its role effectively and to gain its share of the benefits of sustainable development.

The fourth section (means of implementation) includes chapters 33-40: financial resources and mechanisms, transfer of technology and capacity building, science for sustainable development, education and public awareness, national mechanisms, international institutional arrangements, international legal instruments, information for decision making. This section addresses the requirements for implementing those policies outlined in the first section, the actions outlined in the second section, by the various groups of actors identified in the third section. This sequence provides Agenda 21 with its coherence and knits its 40 detailed chapters into an integrated body.

We may consider two of the substantive issues addressed in the second section, namely managing fragile ecosystems: combating desertification and drought (chapter 12) and conservation of biological diversity (chapter 15). For each of the two issues there is an international convention that aspires to mobilize world-wide support towards managing it.

Drought and Desertification

Agenda 21 (chapter 12) defines desertification as "land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities". Drought relates to incidents of rainfall (or other sources of water) being below normal. This recurrent failure is a feature of climate in the dry lands and is a principal cause of the inherent fragility of ecosystems.

Agenda 21 (chapter 12) includes six programmes to be the base of national actions, and calls for international support for these national actions:

A. Strengthening the knowledge base and developing information and monitoring systems for regions prone to desertification and drought, including the economic and social aspects of these ecosystems.
B. Combating land degradation through, inter alia, intensified soil conservation, afforestation and reforestation activities.
C. Developing and strengthening integrated development programmes for eradication of poverty and promotion of alternative livelihood systems in areas prone to desertification.
D. Developing comprehensive anti-desertification programmes and integrating them into national development plans and national environmental planning.
E. Developing comprehensive drought preparedness and drought-relief schemes, including self help arrangements, for drought-prone areas and designing programmes to cope with environmental refugees.
F. Encouraging and promoting popular participation and environmental education, focusing on desertification control and management of effects of drought.

Theses programmes, as implemented at national level, comprise: (1) monitoring and assessment (programme A), (2) management of desertification through corrective measures (programme B). (3) management of drought (programme E), (4) policy and planning measures (programmes C, D and F). Desertification management comprises preventive measures that conserve the production potential of land, corrective measures that rehabilitate damaged lands and reclaim land that was once productive and now desertified. These are mostly actions at the field level that aim at making land use (irrigated farmlands, rain-fed farmlands, rangelands) sustainable. Drought management, not different from management of other forms of natural hazards, comprises three principal elements: early warning system, societal preparedness and mechanism for relief and insurance.

For each of the six programmes, Agenda 21 (chapter 12) identifies activities to be implemented at national level and activities to be implemented through "international and regional cooperation and

coordination". It was also proposed that an intergovernmental negotiating committee (INCD) be established by the United Nations to elaborate an international convention to combat desertification in those countries experiencing serious drought and/or desertification, particularly in Africa. This was endorsed by the UN General Assembly, the INCD was established, worked in a series of sessions (January 1993-June 1994) that produced the Convention that was opened for signature in Paris in October 1994.

The Convention sets in its introductory elements (Preamble, Part I) the justifications for elaborating the Convention, its objectives and its guiding principles. Part II outlines general provisions: general obligations, obligations of affected countries, obligations of developed countries, priority for Africa. This part aims at ensuring the political commitments of various partners that are necessary for the effective actions;.this legally binding commitment was perhaps missed in the 1977 UN Plan of Action to Combat Desertification (UN, 1978) and in the 1992 Agenda 21 (UN, 1993).

Part III, the substantive part of the Convention (Articles 9-21), outlines the action programmes (at national, regional and international levels) and areas for scientific and technical cooperation. Articles 20 and 21 deal with financial resources and financial mechanisms. The action programmes reiterate the contents of the UN Plan of Action to Combat Desertification (1977) and chapter 12 of Agenda 21 (1992). Part IV, Institutions, establishes the Conference of Parties and its supporting bodies (secretariat, committee on science and technology, network of institutions). Parts V and VI address Procedures.

A special feature of the Convention is its four regional annexes. Annex 1: Regional Implementation Annex for Africa is an elaborate document (19 articles) that emulates the main body of the Convention and provides detailed guidance to national, sub-regional and continental action programmes. Annexes II-IV addressing the concerns of Asia, Latin America and the Caribbean, and Northern Mediterranean are brief documents but contain all essential elements.

This Convention and its annexes, while underlining that combating desertification is primarily a site-specific operation and hence the very special importance of national action programmes and the mechanisms for their implementation, show the roles of regional cooperation and coordination in making certain actions more effective. The regions in the Annexes are indicative but not comprehensive, and the main body of the Convention and Agenda 21, chapter 12 call for regional cooperation in all fields of action.

The Region of North Africa

The region of N. Africa extends along the southern Mediterranean. According to the World Atlas of Desertification (UNEP, 1992), Africa north of the Sahara includes Morocco, Algeria, Tunisia, Libya and Egypt, plus Western Sahara and Cape Verde. This is an area of 545.3 million hectares: 385.4 m.ha. hyperarid, 98.1 m.ha. arid, 37.4 m.ha. semi-arid, 15.1 m.ha. dry sub-humid, and 9.3 m.ha. humid. These estimates indicate that 98.3% of these territories are drylands vulnerable to desertification and hazards of drought. Hyperarid territories represent 70.6% of the total area. Soil degradation affects some 40.7 million hectares of productive land: 27.7 m.ha. due to overgrazing, 8.8 m.ha. due to excessive agricultural activities (irrigated and rain-fed farmlands) and 4.3 m.ha. due to deforestation. Le Houérou (1970) estimates that desertification proceeds "at a rate of more than 100000 hectares per year for the whole of North Africa".

The countries of N. Africa, with support from UNEP and ALECSO, submitted to the UN Conference on Desertification (UNCOD, Nairobi, 1977) a feasibility study of a regional project for the establishment of a "Transnational Northern Sahara Green Belt". This was welcomed by the Conference. Steps towards implementation were undertaken under the aegis of ALECSO with a small unit that was to coordinate national programmes. Another transnational project that was submitted to UNCOD addressed "Management of Major Regional Aquifers in Northeast Africa and the Arabian Peninsula". This includes a cooperative programme involving Egypt, Libya, Sudan and Chad. Initial work was carried out involving Egypt and Sudan during the 1980s.

It may be recommended that the countries of North Africa set for themselves, within the confines

of the Desertification Convention and as a sub-regional section of its annex for Africa, a programme of action for combating desertification and management of drought. IUCN and its partners in the UN System (UNEP, FAO, UNESCO and the Secretariat of the Convention) may provide assistance towards elaborating this programme. Such regional programme will provide support to national action programmes especially in areas of:

1. Monitoring and assessment of land degradation, exchange of information related to hazards of drought and locust raids;
2. Management of programmes for combating desertification: preventive measures, corrective actions, etc.;
3. Supporting measures related particularly to training and capacity building, to research and development, and to technology innovation and adaptation;
4. Institutional links with other African sub-regions, the international mechanisms under the Convention, and with other relevant international bodies.

Similar action is needed for the rest of the Middle East.

Biodiversity

Concern with the protection of biodiversity, under the designation of natural heritage, goes back to time immemorial: the Hema system of the Arabian Peninsula (Draz, 1969; Kassas, 1972), the national parks system in North America (Yellowstone National Park established in 1872), the history of IUCN since its birth in 1948, etc. The year 1980 marks a significant landmark: the world-wide launching of the World Conservation Strategy (IUCN-UNEP-WWF, 1980). The general acceptance of this seminal document and the subsequent development, was due to the support of a consortium of IUCN, WWF, UNEP, FAO and UNESCO, of national conservation strategies in several countries in all continents. This was further supported by the UN World Charter for Nature (1982), Caring for the Earth (IUCN-UNEP-WWF, 1991) and Global Biodiversity Strategy (WRI-IUCN-UNEP, 1992).

Agenda 21 (chapter 15) addresses the issue of conservation of biological diversity. Aspects of this broad issue are dealt with in chapter 16 (environmentally sound management of biotechnology) and in chapters dealing with various ecosystems including forests; conservation of biota is inseparable from conservation of ecosystems of which biotic elements are integral parts. The chapter also calls for world wide support to the Convention on Biological Diversity.

Biodiversity is now perceived as comprising three facets: habitat diversity, species richness and genetic materials within species. Conservation programmes need to cater for these facets. In situ conservation entails protection of ecosystems. Ex situ conservation entails protection of species (botanical and zoological gardens, sanctuaries, breeding stations, etc.) and the genetic resources (germplasm banks).

Programmes of action envisaged in Agenda 21 (chapter 15) aim at ensuring that national policies and strategies supportive to the cause of conservation of biodiversity are adopted, that national plans of action are developed and integrated into national development plans and strategies, and that national mechanisms are set to manage the implementation of national programmes of action.

The Convention on Biological Diversity (UN, 1992) was endorsed at the UNCED (Earth Summit) in June 1992 and since December 1993 it has become international law. The Convention addresses a number of issues: conservation of world biological resources, balance between intellectual property (ownership of patent rights of biotechnology) and ownership rights of germplasm material and of indigenous knowledge, provision of technical and financial resources to developing countries so as to enable them to play their indispensable roles in conservation of biological diversity.

The Convention includes a preamble that outlines the issues that need to be addressed and the commitments that need to be upheld. The first 5 articles set an introductory background: objectives, principles, scope, cooperation and use of terms. Articles 6-10 outline the actions that need to be undertaken by Parties (national strategies and programmes for monitoring and assessment, in-situ con-

servation measures, ex-situ conservation measures, sustainable use of biological resources). Articles 11-18 address elements of supporting measures and capacity building: incentives, research and training, education and awareness, impact assessment of development projects and monitoring such impacts, access to genetic resources and to technology, technical and scientific cooperation. Article 19 addresses the sore issue of biotechnology and distribution of its benefits. Articles 20 and 21 deal with financial resources (explicit commitment of developed countries to provide new additional resources to assist developing countries towards meeting incremental costs of implementing measures which fulfil the obligations of the Convention), and financial mechanisms for providing the resources to developing countries. Articles 23-25 established the conference of parties and outlines its functions, its subsidiary bodies. The rest, Articles 26-41, sets the legal frame of the Convention and procedures of its operation.

This convention provides an institution that can deliver, if supported by the unequivocal political commitment of all countries, developed and developing; and it can otherwise remain a forum for exchange of information and of blame. The key to success is not only the words of the Convention but also the deeds of all partners. Here is the cardinal role of the Conference of Parties: Parties can make it the beating heart of a worldwide operation that is effective and sustainable. The point to be made here is that countries should prepare themselves for the effective participation (not just presence) in the Conference of Parties.

The Region of North Africa

The region of North Africa, apart from the present prevalence of aridity, has two features relevant to the issues of biological diversity: it has been inhabited by active human assemblages since millenia, and it is the home habitat of plant species that are parents and relatives of several food and feed crops plants and of hundreds of species that are traditional drug plants. Indigenous animal species bear valuable genetic materials. The long history of human impacts on natural ecosystems and their biota manifests itself everywhere. To this we may add that North Africa is the geographic transit between the warm tropics in the south and the temperate north, not only for migratory birds but also for all aspects of biogeography. This is a region of cultural and natural heritage.

The countries of the region need to coordinate their programmes of action: conservation projects including shared nature reserves at common borders, regional ex-situ conservation facilities, regional networks for monitoring, regional science and technology facilities including centres of biotechnology and centres for taxonomic referral collections. These are areas where regional cooperation is a much more efficient way for using limited resources and for avoiding wasteful replication. A regional strategy for conservation and a regional plan of action may provide a frame within which national programmes can be implemented more effectively.

The countries of the region stand to gain if their conservation policies are made compatible, and if their participation in the Conference of Parties is integrated. This may require a mechanism for ensuring this coordination.

The IUCN and its partners may provide assistance towards elaborating a regional programme of action and the mechanism that is necessary for its support. Similar action is needed for the rest of the Middle East.

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Rapport National du Maroc

Au Maroc, les zones arides et sahariennes occupent 77% du territoire national. Ces terres constituent forcément une composante essentielle dans le développement du pays. L'une des actions importantes entreprises, est la protection des ressources naturelles. La faune et la flore, par leurs richesses et leurs diversités constituent un centre d'intérêt dans les efforts déployés, aussi bien par le gouvernement que par les organisations non-gouvernementales. Ces intrventions synchronisées se conjuguent pour mieux circonscrire les problèmes combien complexes de la conservation d'un patrimoine culturel très fragile, menacé pour une bonne part de disparition. Notre exposé tiendra compte dans son cheminement de ces deux sortes d'actions.

I- La Diversité Biologique dans les Zones Arides: Intérêts et Stratégie:

Plusieurs ONG ont été crées au Maroc et s'occupent de l'environnement de façon générale et s'intéressent à la sauvegarde de la biodiversité sur tout le territoire national, dont une bonne partie est considérée zone aride.
On ne citera à titre d'exemple, que celles qui sont membres de l'UICN à savior:

* l'ASMAPE, Association Marocaine pour la Protection de l'Environnement, qui a une vocation pour l'Education environnementale.
* la SOMADE, Société Marocaine de Droit de l'Environnement, qui s'intéresse particulièrement à l'aspect legislatif (Droit).
* La SPA, Société Protectrice des Animaux, dont la vocation est la protection des animaux.
* l'ALCESDAM qui intervient exclusivement dans la lutte contre les effets de la sècheresse dans les zones arides.

Les ONG sont particulièrement sensibles à la diversité biologique de façon générale et dans les zones arides de façon particulière. En effet, protéger dans ces zones la flore et la faune revient à maintenir les ressources naturelles et finalement à garder le bon fonctionnement de tout l'écosystème.
De plus, les éspèces végétales et animales, vivant dans ce type de milieu, constituent une richesse génétique d'une valeur inestimable compte tenu des possibilités qu'elles offrent pour créer des éspèces nouvelles rustiques et productives pouvant mieux contribuer à la satisfaction des besoins croissants des populations et à assurer leur développement.

Malheureusement, on constate que malgré la volonté declarée, le milieu rural en général et les zones arides en particulier, sont negligés par les pouvoirs publics et ne reçoivent ni l'attention, ni les moyens dont elles ont besoin pour se développer. La conséquence inéluctable est l'accéleration de sa dégradation à cause de l'érosion, la perte du couvert végétal, la disparition des animaux, la progession de l'ensablementet et la désertification accélerée.

La solution à cette problématique ne peut être que globale, regroupant des volets socio-économiques, techniques, législatifs et organisationnels. Cette vision intégrée, étendue sur le court et le long terme, définie de façon scientifique et rigoureuse, et appuyée par des moyens humains et matériels suffisants de la part des pouvoirs publics, est la seule solution à même de répondre efficacement à la nature, à la complexité et à l'ampleur de la problématique posée.

Cette vision doit reposer sur le principe de la solidarité nationale, la complémentarité inter-régionale et une stratégie globale d'aménagement du territoire couvrant les zones marines, les eaux continenales, les montagnes, les zones irriguées, les zones humides et bien sûr les zones arides.

Les zones arides, étant par nature, très fragiles et vulnérables, compte tenu des caprices du climat et la fréquence de la sècheresse, devraient bénéficier du soutien de l'Etat pour une mise en valeur adéquate de ses richesses. La surexploitation des parcours et des plantes par le surpâturage doit être évitée. Les terrasses, les cordons de pierres, les corrections de ravins et les plantations doivent être confectionnées pour limiter l'érosion hydrique. Des plantations arboricoles peuvent contribuer effi-

cacement à la lutte contre l'érosion éolienne. La création de points d'eau dans ces zones est indispensable et le développement d'équipements hydro-agricoles à base d'énergie solaire ou éolienne présente un intérêt certain dans ces régions.

Les ressources naturelles étant généralement insuffisantes dans ces zones, il est souhaitable de rechercher d'autres sources de revenu pour la population. L'écotourisme, les rallyes auto-moto et avions peuvent y contribuer à condition d'éviter toute atteinte préjudiciable à l'équilibre de l'écosystème.

Les actions de développement seraient insuffisantes si elles ne sont pas appuyées par une legislation interdisant le braconnage, l'abus de la chasse et de la sur-utilisation, comme on le constate dans certaines régions, du bois et des animaux pour la production d'articles de l'artisanat et de consommation.

Sur le plan social, il y a lieu de souligner la necessité d'éviter une trop grande pression démographique dans les zones arides et la sédentarisation des populations dans un tel milieu.

De même, il y a lieu de tenir compte systématiquement et pleinement de l'avis de ces populations dans le lancement de toute initiative nouvelle et de rechercher leur pleine adhésion et leur entière participation au projet du devéloppement integré.

La démarche de devéloppement doit être prudente et progressive et reposer sur des projets pilotes présentant le maximum de conditions de réussite.

Ces zones devraient servir de points focaux et de rayonnement pour le lancement d'actions de formation et d'éducation formelles et informelles et également pour la constitution de bases de données et la définition de plan d'actions généralisables à d'autres zones.

La réussite de cette stratégie est conditionnée par la mise en oeuvre de mécanismes de coordination efficaces entre tous les intervenants et les partenaries.

Elle gagnerait également à être intègrée dans une stratégie de coopération entre pays voisins, pouvant permettre l'échange d'informations et d'experiénces et la réalisation en commun de plusieurs actions.

C'est dans ce sens que les ONG marocaines interviennent dans la protection de la diversité biologique souhaitant développer leurs actions dans l'avenir.

Elles renouvellent leur volonté de coopérer avec l'UICN et les pays de l'Afrique du Nord pour réaliser des projets concrets et simples sur le terrains.

Un des projets prioritaires peut être celui de la biodiversité définie dans l'atelier tenue à Rabat du 10 au 12 Mai 1994 et qui comprend 5 composantes.

II- Importance et Potentialites des Zones Arides et Sahariennes au Maroc

II. 1- Importance

L'importance géographique du milieu aride s'impose à l'évidence au Maroc. Le tableau ci-dessous donne la répartition de la superficie du pays en zones économiques dominantes:

ZONE	Sup. Km2	Pourcentage
A- Zone aride	550.000	77
Al-Etage saharien	430.000	60.2
A2-Etage aride	120.000	16,8
B- Zone semi-aride	110.000	15,4
C- Zone humide	53.000	7,4
D- Hautes montagnes	1.000	0,01
TOTAL :	714.000	99,8

En gros, les zones désértiques peuvents schématiquement être situées au Sud de la chaine du Grand Atlas, en suivant l'axe Agadir, Ourzazate, Errachidia, Bouarfa, Oujda. On peut y inclure le plateau de Chemïa et Rhamna au Nord et au Nord-Ouest de Marrakech.

II-2. Potentialités biologiques

II.2.1: La flore:

Réplique du bioclimat, la flore est assez diversifiée sur ces territoitres. Sa répartition qualitative est fonction de deux paramètres principaux: La latitude (aridité) et la longitude (continenalité). Elle se présente comme suit:

a- Steppe à Alfa	32.000 km2	5.8%
b- Steppes chamephytiques buissonnantes et arbustives (Jugubier, Adonecarpes etc...)	82.500 km2	15%
c- Steppes arborisées à Arganier	5.500 km2	1%
d- Steppes sahariennes à Acacia	750 km2	0,14%
e- Steppes désértiques non arborées (dunes-regs-hammadas)	429.250 km2	78,06%

Pour illustrer la spécificité florale de la zone, nous voyons nécessaire de la décrire selon 3 transects Nord-Est du grand Atlas (correspondant à l'isohyète de 200 mm de pluie considérée comme limite supérieure de l'aridité.)

Transect atlantique: Nous pouvons relever successivement:

* Argania spinosa: éspèce endémique, macaronésienne de la région du Souss. S'étendant sur une profondeur de 150 km environ, elle se mélange du Nord au Sud au: Thuya, Génévrier rouge, Peripoca, Euphorbes cactoïdes, ...
* Différents Salsolacés (vermiculata, tetragona, artrophytum, etc...)
* Sur le plateau atlantique de Tarfaya - Laayoune, on distingue des graras (cuvettes plus ou moins importantes) à base de Rhus tripartitum, tamaris divers. Dans les regs, on rencontre surtout des salsolacées et des zygophyllacées.

- Transect médian: (Ouarzazat - M'hamid El Ghazlane)

* Génévrier rouges dans la partie atlasique inférieure, avec Buscus adénocarpus. Le génévrier de l'Atlas est cantonné aux limites supérieures à 2000 m.
* Différentes salsolacées, Adenocarpus, Launaea, Zilla, etc... dans la partie intermédiaire jusqu'au niveau de Agdaz, puis en mélange avec Ac. raddiana, Aristida pungens et tamaris le plus souvent dans les stations plus humides.

- Transect continental: Nous relevons successivement le génévrier rouge et l'Alfa, les salsolacées et adénocarpus sur les plateaux; tamaris dans les ravins, pour aboutir en fin de transect à l'Ac. raddiana et Calotropis procéra.

II.2. La faune

Il peut paraître paradoxale que ces régions arides puissent enfermer un potentiel faunique important. En vérité ceci n'est point étonnant si nous considérons les grands éspaces libres et la fertilité de leur pâturage qui en font une zone particulièrement riche en animaux aquatiques et continentaux. Aussi nous voyons utile de distinguer ici entre ces deux espèces de faune:

II.2.2.1- La faune continentale:

- Animaux à poils: Nous citons en particulier: Le Mouflon à manchettes cantonné davantage en montagne, et les gazelles cuvier et dorcas dans les Hamadas.
- Animaux à plumes: En plus de la faune classique (perdreaux Gambra, pigeons, etc ...), une faune importante bien qu'en partie rare ou disparue, peuple ces territoires. Nous citons: la grande et la petite Outarde, l'Ibis chauve, l'Autruche à col rouge, le grand Cormoran etc ...

II. 2. 2. 2- faune humicole

Celle qui mérite notre attention est celle des grands oiseaux migrateurs: flamant rose, differents canards, échassiers, etc ...

III- Realisations Gouvernementales

Par manque de temps, nous ne traitons ici que des mesures et des actions entreprises directement pour la conservation et du développement de la faune et de la flore, par le Ministère de l'Agriculture et de la Mise en Valeur Agricole, principal intervenant dans le domaine.

III-1- Actions d'ordre général:

III-1. 1- Actions de conservation des eaux et du sol:

Celles-ci intéréssent plus particulièrement la zone atlasique. En effet depuis près d'un quart de- siècle, le Maroc c'est engagé dans un programme ambitieux d'aménagement dans un premier temps des grands fleuves Sud Atlasiques, et dans un deuxième temps des torrents de deuxième ordre. Dans le premier cas, quatre grands barrages ont vu le jour depuis 1970 en vue de la réhabilitation et l'irrigation de près de 2% de la superficie globale de la zone, de régulariser les crues et d'alimenter la nappe phréatique. Dans le deuxième cas, près d'une trentaine de lacs collinaires ont été réalisés dans le même but.

Parallèlement à ces équipements, des reboisements pour lutter contre l'érosion et la mise en valeur des forêts dégradées sont réalisés à raison de 1500 à 2000 ha en moyenne chaque année. La même importance est réservée avec actions de lutte mécanique.

III.1.2- Action de lutte contre la désertification

Celles- ci se sont particulèrement développées depuis un peu plus de 15 ans et se sont déroulées en deux temps:

- Protection approchée: des infrastructures socio-économiques, des oasis et des agglomérations par des fixations physiques (d'abord) et biologiques (ensuite), des dunes de sables ...
- La protection préventive par la fixation à l'origine de départ des sables, Celles-ci se font le plus souvent par des mises en défens, plantations et palissades d'arrêt.

Nous estimons à 2500 à 3000 ha, les superficies ainsi traitées chaque année.

III.2- Actions visant la protection et le développement de la faune et de la flore

Dans leur majorité, les interventions entreprises visent simulanément les deux objectifs, bien qu'à des degrés différents. Aussi nous traitions les deux sujets simultanèment en insistant sur la vocation première du projet et en distinguant entre réserves et les parcs naturels.

III.2.1- Actions visant la protection de la grande faune à poils continentale

La grande régression (due aux pressions anthropiques et à la dégradation des conditions climatiques) qu'a connu ce type d'animaux depuis la période coloniale a rendu nécessaire l'intervention de l'Etat pour conserver ce type d'animaux. Elle s'est traduite par:

III.2.1.1- La création de réserves naturelles

Essentiellement pour conserver et développer les deux espèces de gazelles Cuvier et Dorcas. Ce sont:

- La réserve de Chmaïa: au centre du pays, d'une superficie de 2000 ha où vivent actuellement près de 200 têtes.
- La réserve d'Aferdou près d'Errachidia, équipée récemment sur 2000 ha et qui abrite 20 têtes.

Ces deux réserves visent également la réhabilitation des steppes chamephytiques buissonnanteset arbustes locaux.

III.2.1.2- La création de parc naturel

du Grand Atlas oriental sur 50,000 ha environ. Actuellement 200 têtes y sont recensées. La réhabilitation d'une faune dégradée à base de pin d'Alep, genevrier de phoenicia, buis et Adenocarpus est l'autre objectif

III.2.2- La protection des oiseaux (migrateurs et sédentaites)

Il s'agit essentiellement des zones humides constituées en:

III.2.2.1- Réserves naturelles

- de Khnifis, située au Nord de la ville de Tarfaya dans une lagune de quelques milliers d'ha. Elle con-

stitute une escale privilegiée pour l'avifaune du paléarctique occidental.

La mise en repos de ces terres exploitées jusqu'en 1985 comme mines de sel, permettra aux éspèces halopliles de se reconstituer.

III.2.2.2- Parcs naturels:

* du Souss-Massa: situé sur la côte atlantique comme la réserve précédente. Il s'étale entre Tiznit et Agadir sur une superficie approximative de 34.000 ha. Sa vocation est multiple. Elle vise la protection des éspèces rares et menacées telles que: l'Ibis chauve dont les 2/3 de la population mondiale vivent sur le site. Le grand cormoran découvert au Massa en 1980. Il constitue également l'endroit de passage pour l'avifaune migratrice du paléartique occidental.

Ce parc vise également la réhabilitation des éspèces animales (Gazelles Cuvier et Dorcas). L'autruche (Struthio camelus), etc ..., et la restauration de la flore dégradée (Arganier et, Euphorbes cactoïdes).

* D'Iriqui: Ce parc dont les moyens de financement sont presque acquis est un projet ambitieux qui devra s'étendre sur 120.000 ha, dont 7.000 ha sont occupés par le lac du même nom.

L'objectif visé, est la protection et le développement de la faune saharienne (Gazelles Dorcas, Mouflon à manchettes, Outarde Houbara et rapaces divers), éspèces d'oiseau migrateurs, etc ..., et flore (Tamaris, Acacia raddiana, Acacia albida, Aristida pungens, Cornulaca monacantha).

III.3- Perspectives d'avenir

Ces actions sont appelées à être renforcées par la création à moyen terme de:

- Réserve de Marzouga, dans le Sud-Est du pays pour la protection du lac du même nom, de l'Erg Chabbi et l'ensemble de la faune et flore saharienne.
- La réserve naturelle de l'Outarde Houbara dans la région de Maieder en Sud d'Alnif et protection de l'Acacia raddiana et Tamariçaies.
- Parc naturel de Dakhla dans la région de la lagune d'Argoub pour la protection de l'avifaune migratrice, des gazelles Dorcas et Cuvier, de l'Outarde, des acacias sahariens et la reintroduction de l'autruche à col rouge.

IV- Conclusion

En conclusion la délégation souligne à nouveau la gravité de la dégradation des ressources naturelles dans les zones arides de l'Afrique du Nord et appelle de tous ses voeux à la conjugaison des efforts pour définir et réaliser une stratégie efficace pour arrêter cette dégradation et protéger nos ressources naturelles. L'UICN est particulièrement sollicité pour jouer le rôle qui est le sien pour contribuer à cette stratégie.

Rapport National sur la Biodiversité République Algérienne Démocratique et Populaire

Caractérisé par deux régions phytogéographique méditérranéenne et saharienne le territoire algérien s'étend sur 2.300.000 km2. Sous la triple influence saharienne, méditérranéenne et atlantique il présente un tapis végétal composé de plus de 3.200 espèces dont près de 200 sont endémiques et 640 sont rares ou menacées. L'orographie façonnée par les orogénèses pyrénéenne au secondaire et alpine au tertiaire présente deux grande massifs montageneux l'Atlas tellien et l'Atlas saharien qui abritent les principaux écosystèmes forestiers méditerranéens sur d'immenses surfaces et sous des climats différents. La région saharienne constitue l'un des plus importants écosystèmes désertiques au nord de l'Afrique. La diversité des sols pour la plupart d'origine sédimentaire, influencée par divers micro-climats présente une riche biodiversité dans les domaines de la faune et de la flore.

Ces différents facteurs du milieu ont permis la mise en place d'une population végétale et faunistique particulièrement diversifiée tant au nombre des espèces que des sous-espèces. Un certain nombre d'actions de protection de ces espèces ont été préconisées au niveau des aires protégées. L'inventaire et la caractérisation écologiques de ces espèces méritent d'être pousuivis pour mettre en évidence leur statut biocénotique et leur intérêt scientifique et économique. En ce qui concerne les espèces locales animales et végétales utilisées par l'agriculture, la mise en valeur traditionnelle séculaire a permis de protéger un certain nombre d'espèces, de races et de variétés autochtones qui risquent de disparaitre devant les espèces introduites.

L'existence de systèmes de cultures adaptées aux conditions socio-écologiques dans différentes zones du territoire font partie du patrimoine de la biodiversité et doivent être protégées dans le domaine de l'écodéveloppement. En Algérie, certains phénomènes résultant essentiellement des activitées humaines réduisent sévèrement la biodiversité au sens le plus large du terme.

- l'érosion des sols, perte de près de 40.000 ha/an;
- la perte de terre arable;
- la pollution sous toutes ses formes;
- la désertification, perte de près de 100.000 ha/an;
- la dégradation des différents écosystèmes et la destruction de la faune et de la flore;
- la pollution et la dégradation du plateau continental (1100 km de côte) et la diminution des réserves halieutiques;
- la destruction des paysages et des habitats;
- la perte des richesses naturelles, eau, sol;
- les incendies de forêts: 30 à 40.000 ha/an.

Cette situation est aggravée par:

- une démographie galopante et l'exode rural;
- un climat capricieux à longue saison sèche (5 à 6 mois);
- des calamités naturelles liées à la climatologie, tel le fléau acridien et les sècheresses cycliques;
- un défrichement intempestif;
- une déforestation considérable;
- une mauvaise utilisation des terres;
- un surpâturage éffréné;
- l'assèchement des zones humides;
- la chasse abusive et le braconnage;
- la mise en valeur anarchique sans référentiel technique dans le sud.
- le niveau de pollution inquiétant.

En effet, le facteur "ressource naturelle" n'a pas été pris en considération dans le politique de développement et dans celle de la plantfication. Pour éviter l'aggravation des problèmes de dégradation de l'environnement en général, et de la biodiversité en particulier, que nous vivons, et assurer ainsi un développement durable et harmonieux, il devient impératif que les composantes de la biodiversité soient intégrées comme un paramètre essentiel dans le planification du développement.

En ce sens et suite aux différentes manifestations nationales sur la désertification, les ressources génétiques (4 séminaires nationaux sur les ressources génétiques et leur valorisation) et les assises nationales sur l'agriculture et l'alimentation (Conférence nationale à Alger en juin 1992) où le domaine de la biodiversité a fait l'objet d'un large débat impliquant l'ensemble des secteurs concernés au sein d'une commission spécialisée, un ensemble de recommandations consensuelles a été dégagé dont:

- pour maintenir l'état du couvert végétal présent, il convient de mobiliser les moyens nécessaires en relation avec l'immensité du territoire national et la complexité des actions à mener;
- des programmes pour la préservation et l'extension du patrimoine végétal et animal (terrestre, aquatique) sont ciblés par catégorie;
- en matière de lutte contre la désertification et de préservation des territoires steppiques, les plans d'actions reposent sur deux axes principaux;
- la prévention,
- la restauration.

Cet ensemble de recommandations s'intègre dans le cadre de la Convention de Rio de Janeiro sur la Biodiversité.

En effet, l'Algérie a suivi avec intérêt la conférence des Nations Unies sur l'Environnement et le Développement (UNCED) qui s'est tenue à Rio de Janeiro (Brésil) du 03 au 14 Juin 1992. Ce sommet de la terre a eu à se pencher sur les dossiers importants tels que les ressources génétiques, le droit au développement, le développement durable, la lutte contre la désertification et la sèchersse, la protection de l'atmosphère et les changements climatiques.

Les recommandations de ce sommet intègrent parfaitement nos préoccupations en matière de biodiversité notamment:

- pour la conservation et l'utilisation durable qui revètent la plus haute importance pour la satisfaction des besoins alimentaires, sanitaires et autres de la pollution qui ne cesse de croitre;
- favoriser la coopération internationale, régionale et mondiale entre les états et les organisations intergrouvernementales, et le secteur non grouvernemental aux fins de conservation de la diversité biologique et de l'utilisation durable de ses éléments;
- la conservation et l'utilisation durable de la diversité biologique renforcent les relations amicales entre Etats et contribueront à la paix de l'huamanité; Le programme de recherche et développement pour inventorier et valoriser la diversité biologique des écosystèmes steppiques, arides et sahariens vise:
- à inventorier et le statut écologique génétique et biocénotique des espèces végétales et faunistiques antochtones;
- à mettre en évidence les mécanismes éco-physiologiques des écosystèmes.
- à enrichir le patrimoine technologique agricole, forestier, pastoral par un suivi des espèces adaptées dans le cadre de la préservation et de l'utilisation durable des composantes de la biodiversité;
- à tester des modes appropriées d'aménagement et de développement intégrées, et les techniques pertinentes;

Au niveau du territoire national d'une manière générale les milieux naturels au niveau des zones arides doivent faire l'objet d'une continuité de l'inventaire et de la valorisation des ressources dans le cadre

du maintien des équilibres naturels et de leur exploitation rationnelle.

Dans le cadre de la limitation de la pression du pacage sur les écosystèmes naturels et l'amélioration des qualités des parcours une attention particulière est réservée aux ressources phytogénétiques, d'intérêt fourrager et pastoral ainsi qu'aux bactéries symbiotiques liées à ces espèces.

Les ressources phytogénétiques et faunistiques telles que les palmeraies, la végétation naturelle et les populations de faune, en zones arides, impliquent l'intervention pluridisciplinaire des différentes structures nationales compte tenu de l'immensité du territoire;

Il y a lieu d'assurer le renforcement des capacités d'intervention des structures impliquées dans la conservation de la biodiversité.

Il y a lieu également de favoriser:

- le renforcement du programme de surveillance de l'état de l'environement en milieu naturel;
- la vulgarisation, la sensbilisation et l'éducation du public par différentes voies, notamment en encourageant les associations nationales impliquées;
- la mise en place d'un centre national d'observation de la faune est d'un réseau national d'observation ornithologique;
- le renforcement du laboratoire national d'analyse des résidus et du contrôle de la conformité des pesticides à usages agricoles,
- l'étude des systèmes de productions agropastoraux.

Les travaux menés jusqu'à maintenant concernent les points suivants

- programme de réhabilitation et développement de la faune sauvage en Algérie; par la réalisation des infrastructures pour l'élevage d'animaux en captivité (réserve de chasse de Djetta, réserve de chasse de Tlemcen, Parc National de Belezma);
- comptages annuels hivernaux de la sauvagine,
- inventaires qualitatifs de la faune sauvage au niveau national;
- élaboration d'un programme de la faune sauvage par les actions suivantes:
- études écologiques d'espèces menacées programmes de reintroduction;
- élaboratin d'un inventaire national;
- inventaire et connaissance dans les parcs nationaux et les écosystèmes représentatifs;
- essai de multiplication et de repeuplement des espèces endémiques et rares (flore et faune);
- projet d'extension du réseau des aires protégées;
- projet d'extension du réseau des aires protégées;
- établissement d'une liste des espèces végétales non cultivées protégées en Algérie.

Parmi les contraintes il y a lieu de noter aussi:

- le manque de connaissance et de suivi de la flore et des populations animales sauvages;
- les programmes de formation continue d'agents et de techniciens de terrain, en matière d'i dentification, de reconnaissance, de collecte de données, de manipulation et de préservation de la faune et de la flore sauvage sont encore insuffisants;
- l'état de stagnation du corps associatif et d'amateurs de la nature, au vu de leur difficulté dû au manque d'expérience dans le domaine et en moyen matériel;
- l'insuffisance des moyens logistiques à des actions structurées coordonnées et permanentes.

Dans cet esprit et au vu de toutes les difficultés rencontrées, Il y a lieu de déterminer et d'évaluer les mesures de protection et concrétiser une politique active en faveur de la sauvegarde de la diversité biologique et l'intègrer aux besoins socio-économiques du pays.

Du point de vues législatif et réglémentaire une série d'arrêtés et décrets ont été rédigés et sont en voie de publication, nous pouvons citer notamment les textes suivants:

- arrêté complétant la liste des espèces animales non domestiques protégées. Elle comprendra outre une liste d'animaux invertébrés, une liste additive pour les mammifères et oiseaux;
- décret potrant sur les mesures d'aménagement des millieux de la faune sauvage;
- décret fixant les conditions de captures et d'abattage d'animaux non domestiques et de leur

utilisation à des fins recherches scientifiques et autres.
- décret portant ouverture d'établissements détenant des animaux non domestiques;
- textes sur la chasse et la préservation de la faune sauvage.

Activités prévues
- un inventaire complet et précis de la faune et de la flore sauvage;
- prospection des potentialitées économiques de certaines espèces pour l'expérimentation des systèmes intensif et extensif;

L'organisation d'un tel programme nécessite:
- la sélection génétique des individus;
- l'aménagement du milieu;
- la création de conservatoires botaniques.
- la conservation et la multiplication des espèces endémiques et rares menacées de disparition (conservation ex situ) et leur repeuplement dans les zones ou elles ont existé.
- création d'une banque de données.

Une dynamiques est en cours, elle vise particulièrement:
- la mise au point d'un programme d'échanges d'information et d'expertise en matière d'espèces végétales et animales menacées de disparition et de leur conservation;
- la détermination de statuts de chaque espèce de la faune et de la flore et ce après avoir défini:
- la répartition géographique;
- la susceptibilité intrinsèque des espèces;
- l'abondance et précarité des habitats dans lesquels se rencontre l'espèce;
- l'importance des facteurs limitatifs (chasse, destruction des biotopes, pesticides, habitats, cueillettes abusives, incendies);
- l'importance du déclin des espèces.

Quand il s'agit d'espèces ou d'habitats dont la répartition intérésse les pays frontaliers (Tunisie, Maroc, Niger, Mali, Lybie, Mauritanie) ainsi que les pays avec lesquels l'Algérie a signé des accords de coopération bilatérale, des propsitions de programme sont envisagées.

Le processus en cours permettra sans doute de disposer de données nécessaires pour une meilleure prise en charge des composantes de la biodiversité et leur intègration dans le développement économique et social du pays en harmonie avec le cadre maghrébin en particulier et celui du nord de l'Afrique en général.

Ministère De L'Agriculture
Agence Nationale Poure la
Conservation De La Nature
Jardin D'Essai Du Hemma
B.p 115 El Annasser 16015 Alger

Country Case Study on Egypt's National Biodiversity Planning

ESAM AHMED ELBADRY
National Biodiversity Unit, Egypt

Introduction

Egypt covers a land area of over one million km2 in the hyper-arid regions of North Africa and West Asia astride the Sahara and the Arabian deserts, with an annual rainfall in most parts of less than 50 mm. It consists of three main parts; Sinai (61.000 km2) Eastern Desert extending between the River Valley and Red Sea Coast (223.000 km2) and the Western Desert extending between the River Valley until Libyan borders (681.000 km2). With coastal belts that extend along the Mediterranean Sea from Rafah to the Salloum (850 km2), and the Red Sea from Suez to Halayeb on the Sudanese borders (1100 km2).

Egypt is situated at the crossroads of three continents, and the junction of three biotic realms; Europe, Asia and Africa. The ecosystems found in Egypt with their associated flora and fauna reflect the influence of these distinct biotic regions. The biotic regions in the north are related to those of the Mediterranean basin. The eastern part of the country reflects influences from the Levant and Arabian Peninsula. The biotic regions found in the south are influenced by Sundanian and Tropical Africa, and to the west, areas are related to the Saharan biotic regions found elsewhere in North Africa. Many of the biotic regions found in Egypt represent the extreme limits of their respective ranges, which make the biological diversity found in these areas of special scientific importance.

Egypt throughout the past two decades, has paid increasing attention to environmental issues at both official and popular levels. Following the UN Conference on Human Environment, Stockholm, June 1972, Egypt energetically began formulating a national body responsible for environmental issues, in collaboration with all other concerned bodies. The system developed considerably and comprises a set of integrated components coordinated within a framework governed by a clear concept of development that takes environmental aspects into consideration. At present, the most important component of the national environment mechanism is embodied in an executive body, the Egyptian Environmental Affairs Agency (EEAA) established in 1982 as an affiliate of the Council of Ministers. This body is responsible for setting national environmental policies and their implementation, including conservation of natural heritage. In this, it is supported by a national programme for environmental research sponsored by the Academy of Scientific Research and Technology, and several groups of national non-governmental societies with the participation of women and youth, in addition to all agencies concerned with environmental affairs in the country.

National Conservation Programme

Egypt welcomed the launching of the World Conservation Strategy for the preservation of nature, March 1980, Egypt has been greatly concerned with the issue of sustaining natural resources and conservation of environmental systems and maintaining their continued output and productivity on land, in sea and fresh waters. It has also been concerned with the preservation of the genetic resources of living species, animal or plant, that are threatened with extinction. Egypt has been blessed with numerous places with rare species of living creatures, especially in Sinai, the Red Sea and the north-west coast.

During the 19th and 20th centuries Egypt established institutions, passed laws and initiated activities to protect a variety of plant and animal species, the Ministry of Agriculture (Egyptian Wildlife

Service established in 1970s) was the focal institution for implementation. EEAA, the Egyptian Wildlife Service, and environmental offices in each Governorate came to coordinate their contribution towards implementing Law 102 (1983) concerning the establishment and management of natural protectorates (protected areas). The Prime Minister was empowered to enact decrees for the earmarking of areas in the desert, islands in the River Nile and coastal marine and freshwater systems to be national parks. Several universities throughout the country have new environmental curricula and research programmes and provide technical advice to government agencies. Public and mass media campaigns for environmental conservation has strongly increaed. A profile of Egypt's biological resources is summarized in "Biological Resourses of the Arab Republic of Egypt", a report prepared for USAID (Baldwin et al., 1988).

Protected Areas in Egypt

Areas selected for protection under the dictates of Law 102 represented a wide variety of critical ecosystems ranging from important structural geological formations, wetlands, coral reefs, coastal transition areas, high altitude mountain ecosystems, to a 35 million year old petrified forest.

The Government of Egypt (GOE) has established two funds to provide for the financial needs of protected areas in the country. The first of these by Law (101/1985) and Prime Ministerial Decree 1488/1985 provided financial assistance for pollution prevention and nature conservation in Egypt through the "Toursim and Environmental Services Fund". Through this Law a 25% tax is levied on all international air tickets issued in Egypt in local currency. The second, the "Natural Protectorates Fund" in accordance with Article 6 of Law 102/1983 shall be used to supplement the budget of the administration bodies responsible for implementing Law 102. The Fund was aimed at projects leading to the improvement of protection of the environment, for environmental research and law enforcement. A new bill has been prepared to contribute through this fund to the improvement of the environment in Natural Protectorates. Protected areas in Sinai are funded by EEC since 1989.

Existing Protected Areas

1. El Zaranik-Lake Bardawil, (Ramsar Site), is an internationally important wetland site for birds migrating between Eurasia and Africa. It supports an important artisanal and commercial fishery and an outstanding tourism potential. It has traditional Bedouin settlements and an important historical background.
2. Ashtoum El Gamil-Lake Manzala, is the most important wetland habital for birds in Egypt and the largest wetland in North Africa. It supports a significant number of wintering waterfowel.
3. El Maadi Protected Petrified Forest, contains the petrified remains of a 35 million year old (Oligocene) forest, and provides a record of past environmental and climatic conditions.
4. Saluga and Ghazal Islands (River Nile at Aswan), are important sites for passerine and resident bird species as well as a habitat for a diverse waterfowl fauna, as well as a relict vegetation.
5. The St. Catherine National Park, is a complex system of mountains and valleys harbouring a rich endemic flora and substantial wildlife. The area contains large Bedouin populations and is important to the major religions.
6. El Omayed Protected Area, is a UNESCO Biosphere Reserve. It provides a better understanding of the management problems of the western Mediterranean coastal region of Egypt. It is the site of building simulation models of the ecosystem that could help in providing recommendations for formulating rational land-use schemes.
7. The Ras Mohammed National (marine) Park; coral reefs, desert ecosystem, mangroves, endemic species. This was established in 1983 and with the assistance of EEC, a management plan was set and implemented including a visitor center, a field research and monitoring laboratory and necessary infrastructure.
8. Nabq Protected Area, is a unique system of linked critical ecosystems. These include coral reefs, sea-

grass beds, most northerly mangroves in the Red Sea/ Indian Ocean complex, wetlands, dunes covered by a characteristic stabilizing vegetation, desert ecosystems, brackish water oasis and desert/ mountain ecosystems containing a good representation of desert fauna. This was established in 1992 with the assistance of EEC.

9. Abu Galum Protected Area; coastal and mountain desert ecosystems, coral reefs, genetic resources, landscape, cultural heritage. This was established and funded in 1992 with the assistance of EEC.
10. Wadi El Assiuty Protected Area; desert ecosystem, genetic resources, wildlife management.
11. Wadi Allaqi; a UNESCO Bioshere Reserve for research, wildlife genetic resources, cultural heritage, test area for sustainable agricultural development.
12. Hassana Dome Natural Monument; geological structure, study area, along the Cairo-Alexandria Desert Road.
13. Wadi Rayan; Desert springs, complex ecosystem consisting of 20 mammal species, more than 100 bird species, 16 reptile species; Saharan sand dune ecosystem; marine mammal fossils.
14. Elba Conservation Area; important vegetation, managroves, wildlife, micro climates, landscapes, cultural heritage.
15. Lake Qarun Protected Area; wetland important for migratory birds.
16. Wadi Sannur Cave (Karst); Natural Monument. It contains geological structures known as stalactites and stalagmites, in a fantastic presentation. It has been formed since 45 million years ago during the middle Eocene.

International Conventions

Egypt has signed and ratified a number of international conventions that commit the country to conservation of biological resources (UNEP 1985); Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention), Convention for the Protection of Migratory Species of Wild Animals (Bonn), the World Heritage Convention, Protocol Concerning Mediterranean Specially Protected Areas and Biological Diversity Convention.

The African Convention on the Conservation of Nature and Natural Resources (African Convention, 1968) is considered as the most comprehensive multilateral treaty for the conservation of nature. It requires parties to establish conservation areas for ecosystem protection and scientific conservation plans for the protection of other important resources.

A workshop was held in Tunisia (1993) to discuss and build up a biodiversity programme for IUCN members in North Africa. It came out with the formalization of a regional biodiversity programme for North Africa and a recommendations to encourage the countries in North Africa to develop a national biodiversity programme.

Environmental Action Plan of Egypt, 1992

The National Report of Egypt on Environment and Development to United Nations Conference on Environment and Development (UNCED), Rio de Janeiro, Brazil, June 1992, was prepared by a selected group of national scientists and experts. It was well versed in the spheres of environmental sciences, while abiding by the set framework. The report was also considered by the Board of the Environment Affairs Authority.

The Report depicts the state of environment in Egypt; national efforts to protect environment against pollution, rational utilization of natural resources; conservation of nature and biological species and dissemination of environmental awareness to overcome challenges and problems confronting the attainment of sustainable development.

As plans were being set up for the coming phases of economic development in Egypt, and in the light of mounting global concern, Egypt readily recognized that meaningful success on the economic front cannot be realized without tangible progress in the other intimately related areas of health and

welfare, and sound management of the country's environmental resources and cultural and natural assets.

Advancing towards that ultimate objective, ten working groups of national experts, drawn from different ministries and institutions and non-governmental organizations, were brought together to draw up a high priority environmental action plan for the country. The initial outcome was presented to, and thoroughly discussed with a widely representative and aptly qualified forum. The refined output of this latter process was further scrutinized by a team of experts led by the World Bank and provided by several donor countries; including Denmark, EEC Italy, the Netherlands, Norway, UK, UNEP, Canada, U.S.A. and UNDP.

The described endeavours have taken well over a year of incessant work and culminated in the announcement, at a special conference in May 1992, of the draft of the national environmental action plan for Egypt, including a chapter on protecting Egypt's natural and cultural heritage.

Habitat Diversity: Egypt

Biodiversity has three inter-related elements: habital types (units and subdivisions of biosphere), species, and genetic attributes in the species. Programmes of action need to address the conservation issues of the three elements. But such programmes need to be based on scientific information derived from taxonomic inventories of the biota and ecological surveys of the habitats.

UNEP supported a study on habitat diversity in Egypt. Its purpose is to provide basic information needed for identification of areas that deserve priority protection or conservation management. This study needs to be complemented with detailed inventories of species diversity, a task that requires extensive national programmes of field surveys, taxonomic inventories and revisions, establishment of referral collections, etc.

The first part sets the broad geographical sub-divisions of the country, and considers ecological variations within each sub-division. The second part deals with the fauna, especially the eco-geography of the mammals. The third part reviews available data on soil ecology and soil biota: fungi and fauna. The fourth part describes habitat types and biota of the Red Sea basin with reference to Egypt.

National Biodiversity Unit: Egypt

Egypt has expressed concern over the preservation of the genetic resources of living organisms particularly the plants, animals and microorganisms threatened with extinction. The nation firmly believes that each generation should preserve for the next one a fertile and productive environment, and has therefore put the protection of nature and natural resources in its proper perspective within the framework of the national development strategy and the plans for the utilization of the earth's resources.

In June 1992 Egypt signed the convention on Biological Diversity. Immediately afterwards, a core National Biodiversity Unit (NBU) was established under the umbrella of the Department of Natural Protectorates, Egyptian Environmental Affairs Agency.

Members of NBU are experienced staff representing sectors of government organizations; including Universities; Agricultural Research Institute; National Research Center; Ministries of Agriculture, Interior, Scientific Research, Irrigation and Water Resources and Toursim; the Egyptian Wildlife Service, Giza Zoological Gardens and Academy of Scientific Research and Technology. Non-governmental organizations include: Society for the Preservation of Natural Beauty, Egyptian Society for Preserving Natural Resources, Egyptian Society for Landscaping, Friends of the Trees Society and Friends of Marine Life Society.

Workshop on Egypt's Biological Diversity

NBU held a workshop on Egypt's Biological Diversity in November 1992 and was sponsored by UNEP. Three main topics related to the status and conservation of biological diversity of Egypt were

covered, namely: The national strategy, the economics of biodiversity and systematic inventories of the main groups of plants and animals of Egypt. Twenty six presentations were made by invinted speakers covering these topics. The workshop was attended by an audience from the scientific community, conservation authorities and the concerned general public. Two general debate sessions were also held during the workshop in which participants discussed a variety of aspects related to the consevation of Egypt's biodiversity. These debate sessions resulted in identification of the basic needs for biodiversity consevation and a number of important resolutions and recommendations that were discussed as guidelines for Egypt's Country Study for Biodiversity. The following set of guidelines were adopted:

I- Primary Objectives:

1. to arrive at accurate and realistic assessment of benefit costs and needs of global biodiversity conservation.
2. Information gathered is useful in facilitating political agreement on global costs and funding needs of the planned framework convention on biological diversity.

II- Specific Objectives:

1. Overview of the status of biological diversity in Egypt in terms of (a) present state of knowledge; (b) conservation efforts; and (c) future conservation needs and costs.
2. Basis for establishing priority areas of conservation of biological diversity in Egypt.
3. Identification of techniques and methodologies for cost benefit estimation of biological diversity conservation.
4. Enhancement of national capacity and basic funding of biological diversity conservation.
5. Institutionalize national biological diversity conservation strategy and action plans.
6. Develop understanding among decision makers, educators, economists, social scienists and the general public of the need for conservation of biological diversity.
7. Secure additional parties to, and promote the effective implemmentation of international and regional agreements and action plans.

III- Identification of Basic Needs for Biodiversity Conservation:

1. Overview of biodiversity status; including habitat, species and genetic diversity, areas of high endemism, and necessary nature reserves and ex-situ facilities. This can be accomplished by biological surveys, depositories, GIS and remote sensing mapping, literature search and indigenous knowledge.
2. Sites, species and genomes of significance for conservation. This includes criteria for selection of sites of high diversity, endemism, social cultural importance and threatened habitats. It also includes criteria for selection of species endangered, vulnerable or rare, of national economic importance, their abundance, good indicators of biodiversity, sensitive to human impact and those of international concern.
3. Measures for conservation of biodiversity. This includes lists of necessary actions needed.

IV- The National Strategy:

The proposed national strategy calls for the following actions:

1. Reforming public policies to (a) abandon resource degradation; (b) eliminate uniformity of crops and varieties; and (c) avoid over-use of fertilizers and pesticides.
2. Adoption of policies for promoting conservation and equitable use of biodiversity including (a) asserting national sovereignty over genetic resources and regulate their collection; (b) establishing incentives for biodiversity research; (c) modifying national income auditing to account for loss of biodiversity.
3. Reducing demand for biological resources through (a) family planning services; and (b) reducing consumption through recycling.
4. Supporting biodiversity conservation in the private sector by (a) establishing tax incentives for

conservation; and (b) supporting biodiversity conservation trusts.

5. Incorporation of biodiversity conservation into the management of resources by (a) promoting agricultural practices that conserve biodiversity; (b) restoring degraded lands to enhance biodiversity. 6. Integration of biodiversity conservation into national planning.
7. Correction of imbalance in the control of resources and develop partnership with local communities through (a) reducing pressure on fragile ecosystems; (b) increasing incentives for local stewardship of land; (c) supporting traditional practices; (d) compensating local communities for resources taken for public purposes; and (e) managing resources on public land through new forms of partnership and cooperation with local communities.
8. Creation of institutional conditions for conservation and develpment (a) developing new methods for dialogue and conflict resolving at the regional level; (b) establishing intersectoral and interagency task forces to facilitate planning action; and (c) establishing regional information centers to promote awareness and biodiversity conservation.
9. Encouraging sustainable use of wild resources for local benefits through (a) the recognition of economic value of wild products; (b) increasing local benefits of tourism in natural areas (ec-o tourism) wihout loss of biodiversity; (c) strengthening capacity for maintaining crop and varietal diversity; and (d) developing traditional medicines.
10. Identification of priorities for protected areas by (a) reviewing protected area systems; (b) establishing and strenghtening protected areas; and (c) promotion of international cooperation on protected areas.
11. Ensuring sustainability of protected areas and their contribution to biodiversity by (a) broad ening participation; (b) increasing benefits to people around protected areas; and (c) restoration of degraded land adjacent to protected areas.
12. Strengthening off-site facilities including (a) strengthening genetic resources (crop and live stock) conservation; (b) developing collections of cultures of microorganisms; (c) development of botanic gardens as a major off-site network for conserving wild plant resources; (d) strengthening of conservation role of zoological parks; and (e) strengthening collaboration among off-site and on -site conservation institutions.
13. Increasing awareness of biodiversity values by (a) building awareness of biodiversity into popular culture: and (b) development of biodiversity in formal and non-formal education.
14. Dissemination of information on bidiversity.
15. Promoting research on biodiversity including (a) assessment of biodiversity research priorities; (b) promoting natural sciences research on biodiversity; (c) strengthening connections between biological sciences; and (d) strengthening research on ethical, culltural and religious concerns to biodiversity.
16. Developing human resources capacity for biodiversity conservation by (a) supporting training of professionals; (b) reviving career incentives to increase attractiveness of work on biodiversity; and (c) strengthening capacity of non-governmental organizations to promote biodiversity conservation.

V. The Implementation Plan:

The following plan was formulated to guide the implementation for the national strategy. The plan consists of two implementation phases. The first phase includes immediate, or short-term actions to be taken in the next two years. The second or longer-term phase includes actions to be carried out during the next 20 years.

I. The first phase.

This includes the following actions:

1. Preparatory work: Publication of scientific works and check-lists on the basis of available knowledge.
2. Scientific planning: Laying down the basis for a scientific research plan surveying and monitoring

biodiversity in Egypt, including studies on economic, social and legal aspects.

3. Seeking financial support: Moblizing funds from national and international sources, including debt-for-nature swaps.
4. NGO participation: Supporting scientific and popular NGOs through commissioning special short-term or medium-term tasks.
5. Field research: Strengthening infrastructure in existing protected areas to accommodate scientific programmes.
6. Conservation measures: Including captive breeding of highly endangered species at the existing zoos, and establishing gene banks.
7. International cooperation: Joining international programmes related to biodiversity conservation such as DIVERSITAS program of MAB/IUBS/SCOPE and the IGBP program on GLOBAL CHANGE. Taking first steps towards collaboration with foreign natural history museums to arrange for missions in Egypt and to train Egyptian taxonomists.
8. Legal and institutional aspects: Revising existing laws, regulations, mandates, and structures to accommodate needs of biodiversity conservation.

II. The Second Phase.

This includes the following actions:

1. Documentation; Eastablishing a secetariat for fauna anf flora within the National Biodiversity Unit to keep, classify and publish records and interim reports.
2. Scientific research: Implementing the scientific research plan on surveying and monitoring biodiversity, in collaboration with national and international scientists and foreign natural history museums.
3. Seeking financial support: Continued mobilization of funds as in First Phase.
4. NGO participation: Continued commissioning of special tasks.
5. Field research: Organizing extensive and integrated expeditions for collecting and studying material on biodiversity.
6. Consevation measures: Establishing a wildlife captive breeding farm and open zoos for endangered species, establishing more protected areas and improving their management.
7. International cooperation: Continued participation in international programmes. Sending young scientists to foreign museums and protected areas for training. Solicit help for Egyptian Natural History Museum.
8. Legal and Institutional aspects: Passing appropriate laws and regulations for conservation and sustainable utilization of biodiversity resources in Egypt. Strengthening institutions.

III. Recommendations:

A number of specific recommendations have been made at the workshop. These recommendations cover a wide spectrum of issues related to biodiversity of Egypt and its conservation. The recommendations can be summarized as follows:

1. State of knowledge on biological diversity of Egypt, including identification of information gaps regarding taxonomic groups and geographical coverage, and priorities for species and habitat conservation is needed. A biodiversity data bank should be created to handle such data.
2. Institutional structure: A cetral coordinating agency responsible for providing guidance and direction of work on biodiversity should be identified.
3. The Natural History Museum: A national natural history museum should be established as a central institution for taxonomic research. Available reference collections as well as new material collected by field teams, should be housed at that museum. The museum should be supported by an extensive taxonomic library, laboratories, and other facilities of modern museums. Support for the establishment of this museum should include training of scientists and technicians, supplying field and laboratory equipment, promoting field and laboratory research on animal and plant taxonomy, distribution and conservation.
4. Field work: Field work on biological diversity, including collection of material for reference collec-

tions and gene banks, distribution data of threatened species or habitats, and identification of concerntraion areas of biodiversity should be supported.

5. Conservation of biological diversity: The Egyptian Government should take effective and immediate measures to control illegal hunting as well as extensive trade and export of wildlife which are now seriously endangering this invaluable natural heritage of Egypt.

   Existing protected area system should be re-evaluatd in terms of its representation of species and the effectiveness of their management policies. The Egyptian Environmental Affairs Agency should be given more support to enhance its capability in managing existing protected areas. In addition, local inhabitants of protected areas should be encouraged to take an active role in the management of these areas.

   Environmental impact assessment should be instutionalized as an absolute prerequisitc for the approval of any large scale development project. Projects that will result in significant degradation of the biological resources of the country should not be permitted. Environmentally destructive practices such as the extensive use of chemical pesticides, discharge of hazardous industrial wastes, and over-exploitation of marine and wildlife resources should be controlled.

6. Captive breeding: In view of the fast and widespread decline of many animal and plant species in Egypt, a captive breeding programme seems to be necessary. A center that serves the dual purpose of breeding endangered forms, and conducting basic and applied research on these threatened forms (including local strains of domestic animals and plants) needs to be established. Some of the threatened animals that are kept at the Giza Zoo can be used as a starting stock for the captive breeding program.

7. Laws and legislations: A solid legal framework for conservation of biodiversity in Egypt should be developed. The procedures for the enforcement of existing and new laws should be prepared to assure their effectiveness.

8. Public awareness: Public awareness is badly needed at all levels, and is necessary for the effective enforcement of the law. Training staff, cooperation of the media and integration into the education system are all needed for effective public awareness. An approach based on cost -benefit for the conservation of biological diversity should be used.

9. International cooperation: This should be encouraged in the fields of research, training, collection and identification of material, and funding.

Egypt Country Study On Biological Diversity

In close co-operation with and financial support of UNEP and using UNEP Revised Biodiversity Guidelines, Egyptian NBU undertook on March 1993 the preparation of a country study on the status, costs, benefits and unmet needs of biodiversity conservation in Egypt. National expertise are made use of with the aim to initiate national human capacity building right from the outset and to ensure the continuity of the process.

Objectives

The primary objective of Egypt's country study is to assist the Government to asses national biodiversity status and identify Egypt's basic needs and levels for effective conservation and use of biodiversity and the necessary supportive measures and costs to meet those needs for the benefits associated with the implementation measures. The achievement of this objective would assist in preparation of national biodiversity strategy and action plan.

NBU experts are now gathering information data on biodiversity status, aspects, as well as preparation of check lists and an overview of biodiversity status and identification of gaps in knowledge. The study includes identification of habitat, sites, species and genomes of national importance for effective conservation and sustainable use of terrestrial, marine and aquatic biodiversity; identification

preparation of state of the art reports on the full range of biodiversity components and ranking of key in-country threats, to biodiversity vis-a-vis global threats and identification of measures for technology transfer and land acquisition for conservation purposes required for effective conservation and rational use for each of the identified species or areas of significant biodiversity at a desired level. The linkage of key threats to the proposed measures is considered.

Among the tasks of NBU is the development and adoption of methodologies for estimation of investment costs and unmet conservation needs as well as for defining, assessing and calculating biodiversity values to national economy and for generating knowledge and accurate data on direct and indirect economic benefits generated from biodiversity for each the identified areas / species. Economists are involved in estimation of the total economic as well as incremental costs associated with implementing each of the identified measures over a specific time. The process includes the calculation of the net benefits foregone by not embarking on the proposed measures.

Estimation of the total benefits for each of the proposed measures is considered; actual versus projected benefits, gross versus net benefits; distribution of benefits at national and local levels; benefits from Egypt total biodiversity versus benefits from selected sectors; benefits linked only to the proposed measures versus benefits related to total country's biodiversity; initial investments required to generate the benefits and sustainability in generating the identified benefits. The process also involves the determination of the current level of national, bilateral and multilateral expenditures on biodiversity conservation and its rational use for each of the identified areas / species. It determines the current and projected future unmet financial needs taking into account the issue of incremental costs.

NBU participates in preparation of development and management plans for two protected areas, a captive breeding farm, gene bank and a natural history museum.

Outputs

A country case study on the status of biological diversity of Egypt and the estimated costs of its conservation and rational use. By the end of 1994, the study is expected to contribute to:-

(i) Baseline information on biodiversity in Egypt;
(ii) Biological data on species, habitats and ecosystems and its ex-situ and in-situ management;
(iii) Defined priority areas and programmes for conservation of biological diversity of Egypt;
(iv) A realistic order of magnitude of the costs of biodiversity conservation and its rational use in Egypyt;
(v) Data / information on the economic commodity values of species, goods and service values of ecosystems;
(vi) Trained national personnel in various aspects of assessment of biodiversity;
(vii) A national biodiversity monitoring unit that could be developed into a monitoring center, and
(viii) Preparation of a national biodiversity strategy and action plan as a follow-up to the country study.

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DESERTIFICATION AND BIODIVERSTY IN ARID LANDS: SAHEL EXPERIENCE

By
SOLEYMANE ZEBA
President of the Foundation NATURAMA
Burkina Faso

INTRODUCTION

Ladies and gentlemen, it's a pleasure for me to meet you in this beautiful city of Cairo. This gives me an opportunity to talk about the IUCN Sahel programme experience.

I am the president of an NGO member of IUCN in Burkina Faso, called "Nature's Friends' Foundation", which acronym is NATURAMA. But, before that, I have been the Director of Forest and Wildlife in the Ministry of Environment for 7 years. The IUCN Sahel Programme was born in this period, and I have been lucky to contribute to its conception since 1987.

During this short lecture, I would like to talk about the History of the Sahel Programme, the IUCN Sahel Studies, the projects and activities of the programme, the lessons learned, the regional and international cooperation, and I will suggest some recommendations.

But, first of all, I must tell you that the Sahel region I am talking about concerns specifically the western Sahelian countries including : Mauritania, Senegal, Gambia, Guinea Bissau, Mali, Burkina Faso, Niger and Chad. My topic is entitled : "Desertification and biodiversity in arid lands : Sahel experience".

For simplifying the definition, desertification is the process by which productive lands are becoming deserts. As you know, at the climax stage, deserts have their particular biodiversity of flora and fauna. So, it may mean that in our countries, desertification process is replacing woodlands and their biodiversity, by deserts and their biodiversity. However, the realities are too complex, and many other lectures of this workshop will illustrate this situation.

I. THE HISTORY OF THE IUCN SAHEL PPOGRAMME

In the 16th session of the General Assembly of IUCN, held in Madrid in 1985, a resolution has been taken to set up a programme of conservation, to help the Sahelian countries fight against desertification.

After that, a paper has been prepared by IUCN, and awareness has been raised, which led to a workshop held during the 17th session of the General Assembly in Costa Rica. According to the recommendations, it has been decided to begin with an orientation activity through IUCN Sahel Studies in 1989-1990.

This has been done at the same time with some national conservation strategies in many countries: Mali, Mauritania, Burkina, Niger and Chad.

The field activities started in 1991, with a large variety of contents, due to the specific problems in different areas.

II. THE IUCN SAHEL STUDIES

It was a team work coordinated by IUCN headquarters. Many institutions like UNEP, FAO, WWF, a lot of research centers, have contributed to the analysis. But what are the characteristics of this Sahelian region.

The vegetation found in this region is mainly savannas dominated by grasses and specific tree species such as Acacia and Commiphora, bordered in the south by open Isoberlinia woodlands, and in the north by grass steppes and desert vegetation. The semi-natural woodlands of this arid and semi-arid region have been subjected to overharvesting for fuelwood (particularly charcoal for urban areas) and to intensive grazing and farming pressures resulting from population growth.

Aggravating this situation is the erosion of common property systems for woodland protection and management by public ownership, which, in the absence of Government control, has turned woodlands into open access resources. Degradation has been exacerbated by the low erratic rainfall, implying a slow growth rate and uncertain regeneration.

The drought has started in the western Sahel region in the 1970s, with a lot of consequences: famine, soil degradation, population migrations, a lack of woodfuel, trees dying in many biotopes, wild animals dying during the dry season because the natural ponds are disappearing, extinction of some species of flora and fauna, the poverty increasingin villages, etc...

For these reasons, the complexity of the situation is evident. In fact, nobody can understand the message of conservation when hungry. Of course, poaching and overharvesting have increased, and the priorities of the Governments are turned towards social topics, water supply and agriculture.

The report of IUCN Sahel studies suggests that although rural development efforts, resources management and community participation projects may have had achieved local results, they have, over the last 25 years, not been able to make significant dent in the overall downward direction of trends in soil fertility, vegetation cover and income. Another suggestion is that local action must be accompanied by action at the supra-national level which would favour the removal of a greater percentage of the population from direct dependence on the unassisted productive potential of the resource base.

However, we must recognize that this IUCN report has raised many controversial issues, and some of Sahelian and European specialists did not agree with some conclusions. Nevertheless, the recommendations have led to several types of projects in many Sahelian countries.

Today, we can assume that the IUCN Sahel studies have launched a process of understanding conservation matters in the whole Sahel region, and of hopeful pilot-projects ongoing.

III. The Activities of the IUCN Sahel Ppogramme

Different demonstration projects have started in:

* *Mali:*
  1- making local management of natural resources possible (YOUVAROU)
  2- Walia environmental education project
* *Burkina Faso:*
  3- Management of natural resources and protected areas in the south-east region
  4- establishing a national wetlands plan
  5- sustainable use of wildlife (It's a joint project Burkina/Ivory Coast/Mali on the basis of the lessons learned at the Nazinga game ranch).
* *Niger:*
  6- Land use planning and management in the Aïr Ténéré reserve, aiming at optimizing natural resource value for local benefit.
  7- woodless construction programme
  8- biodiversity activities analysis
  9- Gaya local management plan in 52 villages 10- environmental education project at Zinder.
* Mauritania:
  11- Diawling national park
  12- Master plan to combat desertification (UNDP/UNSO/IUCN).

* *Senegal:*
13- Niokolo Koba national park management action plan
14- the Djoudj national park (a Ramsar and Biosphere Reserve site).

IV. The 1992 Review and the Perspectives

The recent natural resources management projects in Niger, Burkina Faso and Mali have been extremely innovative, employing a participatory approach, that concentrates on decentralized, participatory, and multi-sectoral natural resources management. A key element of this approach is the preparation of a land development plan by the local community with the assistance of a multidisciplinary team of technicians.

The Sahel programme has not yet revised its programme and policy declaration (1990) as a result of the 1992 review. A process of redefinition has been on-going during 1993, and has included the drafting of a paper in the context of the Sahel studies, the holding of a regional members meeting, and the delegation of lead responsibility for programme direction to the field.

From this, a number of issues have emerged, which will no doubt inform the revised policy declaration and increasingly be reflected in the activities undertaken under the programme. Some of these are:

* political and administrative decentralisation of West African States, and the consequent adaptation to more desirable resource management practices.
* What is the potential contribution that wild resources can make to quality of life that they are not already making? Will legislation of certain practices (hunting/gathering) promote manage ment that conserves biodiversity? *What future for protected areas in a context where most of them exist on paper only and where pressure for land consumption for subsistence production is severe?

V. Suggested Recommendations

1. To promote demonstration projects using a holistic approach of natural resources management, that concentrates on decentralized, participatory, and multi-sectoral interventions. The field strategy of these projects must lie on the local communities with the assistance of a multi-disciplinary team able to link biodiversity conservation and development.
2. To consider arid land's wetlands as hotspots for biodiversity conservation. For that, a few wetlands might be selected for pilot projects.
3. To emphasize environmental education, particularly on biodiversity, in order to raise public awareness, as an important element of the global Action Plan.
4. To link the implementation of the two Conventions on Biodiversity and on Desertification, when elaborating development projects for arid lands.
5. To develop game ranching of specific species such as ostrich, and threatened mammals, in collaboration with some local communities and private investors.
6. To develop cooperation between the North Africa programme and the Sahel Programme, particularly on arid lands flora and fauna preservation.

VI. Regional and International Cooperation

A lot of environmental problems cannot be resolved at national level. I think also that nature conservation can foster the linkage between people of a same region. That's why IUCN networks, Commissions and programmes, are very important.

In the Sahel region, it gives us opportunity to cooperate, to exchange information, and to look in the same direction. We have had 2 workshops in Mali in September 1993 and in Niger in September 1994, to evaluate our activities. Here, I have the honour to encourage your workshop and congratulate all your members. We are doing the same work in different ecosystems.

At the international level, IUCN is doing its best to promote cooperation, together with other institutions and countries.

Conventions such as the Biodiversity Convention and Desertification Convention can be good tools for cooperation.

But, we must pay attention to some declarations stating that biodiversity support is to be given only to tropical moist forests countries of Africa and Latin America. Everybody must know that arid lands have their specific biodiversity of great interest. Hopefully, some partners such as Switzerland are demonstrating the right way.

STATEMENT OF THE INCD(*) DELEGATE

By
GREGOIRE DE KALBERMATTEN

SALUTATIONS, GREETINGS FROM THE EXECUTIVE SECRETARY OF INCD

The elaboration of the international Convention to Combat Drought and Desertification in countries experiencing serious drought and/or desertification, particularly in Africa, is meant to bring about a sort of "NEW DEAL" between members of the international community, development practitioners and local populations to reverse land degradation in arid lands, particularly in Africa. This will have far reaching implications for the protection of biodiversity in affected countries.

I am pleased to report that 86 countries, mostly African and OECD countries, have signed the Convention on 15 October in Paris. Gathering the statutory 50 ratifications for the Convention to enter into force may take two years. In other words, the first Conference of the Parties would take place in 1997. Of course, the resolution on urgent action for Africa reminds us that action cannot wait. The task ahead during the interim period is considerable and the stakes are high. At the signing ceremony, donors indicated that at least one to two billion USD would be available for the implementation of the Convention during the interim period. Some of these resources could and should be devoted to sponsoring more innovative and participatory approaches in protecting biodiversity in arid lands.

This is why we are so grateful for the opportunity to participate in this workshop and benefit from the collective wisdom of this group; our Secretariat has a mandate for managing information, and facilitating the launching process of the resolution on urgent action for Africa...

Allow me to start with a few remarks of a more general nature.

Today, it is recognized that there is much more to desertification than the containment of moving sand dunes. It is difficult to grasp the full impact of the loss of the agro-ecological balance in arid lands but it is safe to say that desertification implies the potential genetic erosion of the plants, animal and microorganisms that constitute the biological diversity of dryland environments. The loss is great because species and genes adapted to dry conditions are few while 900 million people are at risks of desertification of whom many would, to a considerable extent, feed on drylands crops and animals. This all leads to the deterioration of living conditions.

The impact of consequent socio-economic hardships and erosion of cultural intergrity cannot be over-emphasized. For instance, the Ameria Symposium organized by the Government of Spain and INCD in February of this year, explored the relationship between desertification, migration and conflicts, and found environmental causal factors characteristic of the drylands in almost half of the fifty or so armed conflicts that were raging at that time.

The preliminary findings of a study, conducted by the International Panel of Experts on Desetification, suggest that desertification hits biodiversity on every continent, with potentially severe impact on food security. Of course we need to know much more on the subject; the mapping of biodiversity in arid lands has been rather neglected in the last decades. But there is no question that the biological carrying capacity of the dryland is threatened and therefore, we need to act now. It is at this juncture that the Desertification Convention presents a major opportunity to protect arid land biodiversity with a new effectiveness.

This Convention can be visualized as a five stories pyramid. First, the ground floor, the local level which is crucial for our purpose and I will revert to it; then the national level; the sub-regional level, it would be UMA for Northern Africa; then the regional level, concerning the African continent; and

* INCD= Intergovernmental Negotiating Committee on Desertification.

finally the top of the pyramid, the global level where the Secretariats of the Bidiversity and Desertification Conventions are located. The four last stories must be understood as a superstructure to serve the first one, the local level, the field in affected areas where the impact of all planned measures must ultimately be felt. The challenge before us is to take the action down there.

One might describe this Convention in various manners. It is the first significant multilateral instrument to be adopted after the Rio Earth summit. It integrates environment protection with a more sustainable and human development. It balances the interests of the North and the South in meeting the expectations of the latter with respect to the global management of natural resources. It provides donor countries with an enhanced convergence of operational policies and the needed framework for integrated strategic planning. It identifies the primacy of the fight against poverty to restore degraded land. Without pretending to innovate in the technical aspects of the combat against desertification, the Convention draws the - sometimes bitter - lessons of past experiences to propose another way of manageing natural resources. It anticipates the people-centered approach to development that will be one of the foci of the forthcoming World Summit for Social Development, (Copenhagen, March 1995).

In a sense, the Convention is probably the first legally binding international instrument which replaces so clearly the notion of Aid with the one of partnership. No more supply driven initatives down the one way street of the financial flows, but an exchange among all, which should maximize the potential of everyone. Early and consistent coordination of assistance is a direct consequence of the Convention's provisions. This partnership, of course, associates the government, the NGOs and the local communities with the international donors. We can summarize it in one sentence: no partnership in the outcome without a partnership in the process.

The key feature of the implementation of the Convention is the launching of a genuinely consultative and participatory process which gathers all concerned actors of the civil society in affected countries. The commitment of local populations and a greater decision-making power to decentralized authorities are considered to be necessary conditions for a more sustainable impact of planned actions. The preception of the end users must be integrated up front in the programming phase. It is important for international partners, in the meantime, not to confuse matters by sponsoring an entropic multiplicity of strategic planning frameworks which overlap with each others, stretching thin Government resources, confusing local authorities and discouraging intended beneficiaries. Indeed we must achieve a homogeneous planning framework to combat desertification and protect biodiversity in arid lands.

The shaping up of this mechanism at the national level is described in Article 18 of the Regional Implementation Annex for Africa which could be said to be the implementation edge of the Convention. The Resolution on urgent action for Africa in its operative paragraph 8, reaffirms the priority of partnership arrangements at national and sub-regional levels in the affected African countries. These partnership arrangements, leading to the conclusion of agreed upon medium term investment programmes, can become privileged platforms for developing integrated biodivesity protection initiatives in arid lands.

How can biodiversity be built in the process?

Desertification is about the degradation of arid lands and related natural resources potential, a complex process which still needs to be much better understood but which certainly includes a broad range of parameters and measures which are crucial for flora and fauna species conservation. International partners may intervene at all levels: more globally through early warning systems, the collection and standardization of basic data sets or the development of mapping systems. They can launch specific initiatives at the regional or sub-regional levels. They may usefully intervene in all their traditional technical fields while promoting institutional strengthening, capacity building and technology transfer. And they can do much more.

In order to reach the intended beneficiaries of the Convention, priority must be given to participatory eco-development programmes, in French, "du type gestion des terroirs" in affected African

countries. These programmes may remove the pressure of vulnerable groups on the fragile environment by diversifying their economic options. The concept proposed is to exchange the demand driven programme inputs which meet the immediate, self-identified socio-economic needs of the population against their active commitment in longer term activities beneficial for the environment, for instance, relating to biodiversity protection. Such activities suggested during the INCD preparatory process include for instance:

i)- Linear plantation of fodder on arable land and migratory routes combined with rotational grazing ; ii)- village schemes integrated in farming systems; iii)- development of alternatives to forest products including alternative sources of energies and changing design and material for housing and fencing; iv)- research and development on fast growing tree species suitable for drylands afforestation; v)- community based seed collection, storage and distribution of indigenous multipurpose trees; vi)- forest protection schemes againt pests and fires; vii)- strengthening of national institutional capacity for wildlife protection; viii)- regulation of the consumptive use of wildlife resources and promotion of non consumptive use of wildlife resources through income generating activities;

This list cuts across sectors as divers as forestry, range management or tourism. Perhaps it suggests that we must follow an holistic paradigm and that bio-diversity protection must be approached from various angles. If so, the comprehensive NAPD would provide a relevant framework for coordination at the local level. It is also interesting to note that the type of measures proposed combine by the population during the INCD case studies - (in Botswana, Mali, Uganda, Tunisia) - often a biodiversity protection with income generating opportunities at the local level.

Let me add, Mr Chairman, a few concrete information on the steps that should now be taken by affected countries?

To begin with, we should not reinvent the wheel: the Convention builds on past experience and existing planning frameworks. Basically, as a first step, Governments are expected to designate an appropriate national coordinating body to function as a catalyst at the national level in the preparation, implementation and evaluation of the NAPD. The Secretariat of this body, functioning as a national focal point, is usually located in the Ministry of Environment, Rural Development or Agriculture.

The national focal point will then i)- review in the light of the Convention the institutional and budgetary measures to be taken by the State, ii)- Convene a broad base consultative process with the civil society and international partners, iii)- undertake a participatory assessment of past and current action and proposed implementation strategies, iv)- organize a national forum to formalize the interactive process leading to the convening of a consultative group in which partnership agreements would be concluded. These agreements will determine the financing packages to fund the NAPD, and their biodiversity components.

In this last respect we should work together with IUCN to better establish the interface between land degradation and biodiversity as one of the GEF focal areas. This is a task of overriding importance. We may think about targeted research projects, in-situ conservation programmes, production of valuable dryland products (resins, gums, pharmaceuticals) or selective support for dryland nature reserves, and view these activities as integral parts of dryland ecosystems conservation.

FAUNA IN NORTH AFRICA
ACTUAL SITUATION AND PERSPECTIVES

By
BRAHIM HADDANE
IUCN member coordinator in Morocco
(ASMAPE)

INTRODUCTION

The North Africa region with its 5 countries has few National Parks with several protected areas, but the potential for development is great (Table 1). Most of these countries have already started to make good use of cultural and historical sites as Desert, Mountain or Coastal areas. The natural beauty of wilderness is a valuable source of pride for humanity and the introduction of conservation notions and management policies and practices has a great deal of importance to set. However, so far little has been done to preserve or to rehabilitate wild animals for their sustainable use for different purposes (protein production, tourist attraction, hunting potential or development of parks and recreation areas). The Islamic instruction and guidance on animal rights and man's obligations concerning them are so comprehensive that we need not to go elsewhere for any guidance. As believers in the consummate and conclusive revelation of God, we are expected to learn from the misconceptions of the past and consider the holy approach to religion. Fourteen centuries is a long enough period to grasp mentally the fact that spiritual development does not lie exclusively in ritualistic observance. Surely it is a long period to liberate ourselves from the pre-Islamic traits of our respective cultures. The most alarming and distressing predicament of this deplorable state of affairs is that our Islamic countries too have started treading in footsteps of the West in the name of commerce and trade. No doubt we have a lot to learn from Western technology and science but surely animal welfare and environmental conservation is not one of these subjects. It is only during the last few decades when United Nations has organised many international conferences about the Environment and Development issues (Stockholm 1972, Tibilissi 1977, Rio de Janeiro 1992, Cairo 1994 and the previous General Assemblies of IUCN: Perth 1990, Buenes Aeres 1994), which allowed us to debate the most crucial subject related to conservation and development, that most of the countries have established National Parks or Protected Areas policy in order to save what is left of their flora and fauna species and their habitats with the possibility to rehabilitate species from other countries with similar ecological conditions. Some field studies and surveys have been undertaken locally to find out the magnitude of the disaster and suggest adequate solutions.

NATURAL FEATURES

The North Africa region extends from the Atlantic Ocean in the west to the Red Sea in the East, covering a distance of some 3700 km length and 2000 km wide. The last dry period previous to the present one in North Africa was 20 000 to 15 000 years B.C. During this period the North African and Arabian deserts were formed causing the formation of sand dunes, the depletion of vegetation and a decrease in the numbers of many wildlife species which in many cases became endangered or even extinct. While the vegetation cover deteriorated, fertility declined, salinity increased and water resources diminished. This helped to increase erosion and desertification. Eighty percent of the area is considered arid and semi-arid, only twenty percent is sub-humid. Wide temperature fluctuations occur as high as 50oC on a diurnal basis. The high temperature causes high evaporation and reduces

the effectiveness of the local and erratic rainfall from convection storms. During most years desert rainfall is less than average due to an occasional year with heavy rainfall that raises the average. Due to low annual rainfall and because most storm events provide less than 25 mm of humidity there is little leaching of minerals especially salts, so desert soils are often high in minerals. Of equal importance, more vegetation is produced on these sites with natural irrigation than would be available with normal rainfall alone. The riverbed banks are the moist sites of desert and the places where shrubs and grasses with deep roots grow.

The Sahel band across Africa is in this Zone, toward drier conditions, plants become more widely spaced and shrubs change to include typical species like Artemisia, Calligonum, Haloxylon or others. The shrub-like grass is common in the Arabian and Saharan deserts where soil is a stabilized sand plain and rainfall is between.50 mm and 100 mm.

The climate of the region is affected by the following factors:

- The latitude: the region is situated between 2o and 35o N Latitude, which is a hot, dry zone and includes the large Saharan Desert.
- The continental effect of the lands situated around the main region.
- The water resources: The mairtime effect of the region is small, due to its huge area with small size of inland water points and the great distance from the sea.
- The high situation of the mountain chains above sea level, against the direction of the rainy winds, that stops any influence toward inland.

The region is marked by two rainbelts and may be divided according to the climate to:

- The Mediterranean zone which is of the winter rainbelts. Characterized by two distinct seasons: the rainy winter, warm, and the dry summer, hot. The amount of rainfall varies according to site, relief and coastal line. The highest amounts fall in the North African coastal line and the eastern Mediterranean.
- The Desert zone which is a very dry belt within the Sahara southward.

The whole region suffers from extremely wide variations in temperature, aridity and wind. The deterioration of the soil due to decrease of vegetation cover creates conditions of desertification. This occurrence can be attributed mainly to the misuse of land and other natural resources like over-grazing, over-exploitation of wood for fuel and construction, clearing of poor marginal land for agriculture, poor irrigation methods and high salinization.

WILDLIFE ANIMALS

It is believed that some four to five thousand years ago the whole North Africa region had climatic and ecological conditions similar to the present savanna area of Africa and that wildlife animals were abundant in number and species of all sizes from giraffe to monkeys across carnivores and small herbivores. Forests and open savanna with grasses covered the land and water was available everywhere.

After the severe dry period, wildlife animals popultions decreased or migrated to other areas with better humidity and enough fodder.

With the development of modern civilization and the increase of the human population (Table 2) and the related activities: natural resources and particularly wildlife animals faced severe competition from domesticated animals and in many areas deterioration reached the point of extinction for many species.

There are two basic groups of wildlife species in North Africa countries. One exists as native species of the area and the second group represents the migratory species visiting the region seasonally.

Wildlife animals had to struggle for survival and the situation is extremely critical. Most of the indigenous species have either been exterminated or on the verge of extinction because of human practices which are destructive to both the animals and their natural habitats.

	MOROCCO	ALGERIA	TUNISIA
NP	6	9	7
PA	8	4	8
Oth.	4	4	4
Future	2	6	14

Table 1: Protected areas in Maghreb countries
NP=National Park, PA=Protected Area, Oth. Other forms of protection

COUNTRY / Population (1000) / Year	MAURITANIA	MOROCCO	ALGERIA	TUNISIA	LIBYA	TOTAL
1990	1 999	25 278	25 344	8 235	4 710	65 566
2000	2 673	33 248	34 064	10 593	7 292	87 870
Area km2 (1000)	1 031	710,85	2 382	154,53	1 755	6 033,38

Table 2: Population and area of UMA countries.

The natural habitats of wildlife animals have been invaded by livestock animals whose extensive mobility has been adequately improved. Being terrorized and squeezed into a limited space with diminished food sources the wild animals have declined in number. Consequently reproduction has almost stopped, while survivors have often been shot.

In North Africa there are three groups of species:

The extinct species that may be reintroduced from other regions or neighbouring areas: this group includes many big size animals particularly:

- Addax (*Addax nasomaculatus*)
- Scimitar horned oryx (*Oryx gazella damah*)
- Dama mhor gazella (*Gazella dama mhor*)
- Red neck ostrish (*Struthio camelus camelus*)
- Hartbeest (Bubal) (*Alcelaphus buselaphus*)
- Barbary lion (*Panthera leo leo*)
- Saharian crocodile (*Crocodylus niloticus*)

The second group includes all the endangered species that still occur in small groups. Their survival in the future depends on how much efforts are put to preserve them for the next generations.

- Mountain gazelle (*Gazella cuvieri*)
- Plain gazelle (*Gazella dorcas*)
- Barbary sheep (*Ammotragus lerviae*)
- Barbary leopard (*Panthera pardus*)
- Lynx caracal (*Felis caracal*)
- Serval cat (*Leptailius serval*)
- Cheetah (*Acinonyx jubatus*)
- Striped Hyaena (*Hyaena hyaena b.*)
- Fennec fox (*Fennecus zerda*)
- *Uromastix acanthinurus* and *Uromastix geyri*
- Desert monitor (*Varanus griseus*)
- Puff adder (*Bitis arietans*)
- Daudin's Viper (*Vipera libetina*)
- Greek Tortoise (*Testudo graeca*)
- Hubara bustard (*Chlamydotis undulata*)
- Arab bustard (*Ardeotis arabs*)

The situation of reptiles and amphibians is somewhat better due to their high capacity of multiplication from eggs and owing to their low interest as game.

Among the third group we can find all the animals occurring in abundant numbers and their exploitation is regulated by the national existing legislation based on the sustainable use of natural resources, adapted for each country. The legislation lays down the use of the wildlife animals for tourist attractions and the improvement of the income of the local communities.

Areas/ecosystems	Surface (km2)	%
Arid area	546 000	77
Semi arid	110 000	15,4
Humid area	53 000	7,4
Mountains area	1 000	0,15
T o t a l	710 000 Km2	99,95

In Morocco the management policy of natural resources was established as early as the beginning of the fifties when the first protected areas were created. Then many other actions were undertaken to achieve the term of conservation ex situ and completed by the following highlights activities:

1985: Release of Atlas monkey (Macaca sylvana) in the mountain area and Dorcas gazelle in arid protected area.

1990: Reintroduction of Atlas deer (Cervus elaphus) to be rehabilitated in the Atlas Mountain eco system within a national park.

1992: Reintroduction of Dama mhor gazelle that was released in a semi-arid protected area.

1994: Reintroduction of Addax antelopes and Dama mhor gazelle to be released in the Massa National Park located in the South West of Morocco covering semi-arid and arid protected areas.

The reintroduction of the Red neck ostrishes is planned in the future.

Perspective in the Future

What is the situation and how should it be conceived in the future?

There are two levels of intervention:

a/ At the State level:

- Solid and adaptable legislation should be prepared to protect and to conserve natural resources.
- Wide and efficient policy and management of Protected Areas establishment including all ecosystems.
- Reintroduction of the extinct species from other areas and helping to increase the size of the endangered species populations.
- Formation and training of staff for this purpose in good numbers and adequate qualifications.
- The international or regional conventions should be signed and ratified.
- Adoption of sustainable development policy and not only global one.

b/ At the individual level:

- The Government of Morocco has issued a Royal Edict (Dahir) of 15 Nov. 1958, regulating and allowing the creation of any association or "NGO" which allows volunteer people to set a group and to work together in an organisation.
- Any person can participate to the action of conservation at all levels: Politicians, educators, decision makers, technicians, businessmen, etc.
- Formation of groups of individuals and creation of NGO's aiming at the mobilisation of public opinion for the conservation and the protection of the environment and particularly biodiversity.
- Education and public awareness: Good programmes on the subject for local population using all the media (TV, Radio, Press, Pamphlets, Posters...).

CONCLUSION

Whatever are the reasons, the sustainable use of natural resources should be a priority in the policy and the management of any regional or national programme of development.

Biodiversity in Arab countries, like other natural resources, has been subject to misuse for centuries.

As mentioned previously the main problems facing wildlife are:

- Deterioration of natural habitats due to deterioration of vegetation bringing erosion or desertification aspects.
- Overgrazing and severe livestock competition in all rangelands especially in the marginal areas.
- Severe hunting and poaching using modern weapons and four-wheel-drive vehicles which can reach previously inaccessible areas.
- Marine and fresh water over-exploitation, destruction of egg-laying areas or egg collection, killing of monk seals by fishermen and pollution of coasts.
- Extinction of many land species from most areas and even native cultivars are threatened.

For biodiversity conservation and management, the threats should be completely prohibited and precise protection measures should be taken at the national or regional level with sustainable development.

Mise en oeuvre de la Convention sur la Diversité Biologique (C.D.B.)

Par

ZOHIR SEKKAL

Membre Fondateur du Mouvement Ecologique Algérien (MEA)

L'Afrique est le plus sec des continents, elle contient la plus vaste superficie des terres sèches couvrant presque 18 millions de km2. Les zones arides sont souvent des déserts comme le Sahara et le désert de Kalahari.

De nombreux écosystèmes arides ou semi-arides sont fragiles et ont un faible rendement; ils nécessitent des pratiques spéciales d'utilisation des sols pour mettre en valeur leur viabilité. La mauvaise gestion et l'exploitation irrationnelle de ces terres ont conduit à la désertification. Plusieurs de nos pays sont affectés par la sécheresse et la désertification. On estime que le Sahara s'agrandit au rythme de 1.5 millions d'ha par an. De ce fait la perte de diversité biologique est énorme.

Les zones arides et sémi-arides d'Afrique ont permis l'évolution de variétés de plantes, d'animaux, de microbes et de gènes spécialisés bien adaptées aux conditions de sécheresse, parmi lesquelles les températures élevées. Ces régions sont elles-mêmes des écosystèmes spécialisés dont les services et les produits soutiennent la vie de nombreuses populations et des économies nationales. Elles constituent aussi un laboratoire naturel inestimable d'espèces et de gènes désirables dans la sélection de variétés phytogénétiques et zootechniques résistantes, entre autres caractéristiques souhaitées, à la sécheresse. Comme ces écosystèmes fragiles et à faible rendement sont importants sur le plan socio-économique et biologique il est nécessaire:

- que l'exploitation et la mise en valeur de ces écosystèmes se fassent selon des principes écologiquement rationnels et viables.
- de renforcer et d'adopter diverses initiatives et/ou plans d'action visant à combattre la sècheresse et la désertification.

A ce titre s'inscrivent le plan d'Action des Nations Unies de Lutte Contre La Désertification, les Plans d'Action de Lutte Contre les Incidences de la Sècheresse en Afrique, le Programme de la Conférence de Lutte Contre la Pauvreté et la Dégradation de l'Environment organisé en 1993 par la Conférence Ministérielle Africaine sur l'Environnement (C.M.A.E.), le Centre d'Activité de Programmes de Lutte Contre la Désertification du P.N.U.E .... Parmi les autres initiatives, au niveau sous régional, on peut citer, pour ce qui nous concerne, le Bureau des Nations Unies pour la Région Soudano-Sahélienne (B.N.U.S.), le Comité Permanent Inter-Etats de Lutte Contre la Sécheresse dans le Sahel (C.I.L.S.S.), l'Union du Maghreb Arabe, la Ligue Arabe et ceci afin d'assurer tout le succès voulu à la mise en oeuvre de la Convention sur la Diversité Biologique.

La mise en oeuvre des dispositions de la Convention sur la Diversité Biologique repose sur la disponibilité des ressources humaines en quantité et qualité suffisantes à l'échelon national, sous-régional et régional. Nous connaissons une pénurie aiguë de personnel qualifié, bien formé en matière de diversité biologique. Les personnes que l'on emploie sont peu entrainées, mal équipées et mal rémunérées. Le travail de terrain ne dispose pas de personnel qualifié et expérimenté suffisamment au courant du concept de la diversité biologique. Les rares cadres compétents travaillent dans les Administrations centrales ou aux Ministères en qualité d'aministrateurs et de bureaucrates. De telles carences limitent la capacité de tout pays à planifier et à gérer des programmes efficaces de conservation tout en exposant la diversitè biologique à des forces destructives. Ces conditions limitent également la capacité des pays à recevoir des fonds internationaux destinés à la conservation de la diversité

biologique. Pour pallier à ces insuffisances il est à récommander que chaque pays puisse former un personnel approprié chargé de la diversité biologique tant au niveau technique qu'au niveau professionnel en lui offrant des conditions de travail et de rémunération attrayantes. Des programmes appropriés peuvent remédier à la grave pénurie de personnel dans différentes disciplines de la biodiversité et ce au niveau national et sous régional.

La mise en oeuvre effective des dispositions de la Convention sur la Biodiversité nécessite la création de moyens et d'institutions au niveau régional. Le réseau de la C.M.A.E. en matière de diversité biologique convient à cette fonction et devrait par conséquent être renforcé, L'U.I.C.N. peut dans ce cas jouer un rôle dans la mise en place d'une stratégie au niveau régional et peut jouer un rôle dans la renforcement des institutions qui s'attachent déjà à la conservation de la diversité biologique telles que les institutions de formation à la flore et la faune sauvage, les banques de gènes, les centres de sémences, les musées et herbiers, les jardins botaniques et zoologiques .... Les institutions qui s'occupent de la flore et faunes sauvages et des sciences de l'environnement devraient être réorientées pour s'occuper de manière efficace de la diversité biologique et des questions de viabilité.

Dans nos pays il existe de nombreuses lois sur la protection de l'environnement. La législation qui existe en Algérie n'est pas très détaillée et ne couvre pas toutes les dispositions de la Convention sur la Diversité Biologique. Celà est sans doute vrai pour les autres pays de la région. Des efforts doivent être déployés pour redresser cette situation. Quand un pays signe une Convention il est nécessaire de passer en revue la législation existante afin d'inclure les diverses dispositions d'une convention. Les Lois qui s'harmonisent avec la Convention constituent les instruments de base de la mise en application de la diversité biologique et des autres conventions qui s'y rattachent. Les lois qui vont découler de la CDB devraient incorporer des éléments tels que: une politique officielle sur la diversité biologique, la législation d'application de cette politique, la participation des collectivités locales, les droits de propriété et le partage des avantages, la possibilité d'octroyer un brévet au caractère endémique des plantes et des animaux afin de faire en sorte que des avantages économiques équitables reviennent à nos pays respectifs. Si la législation est éparse il est indispensable d'assurer à l'échelon interministériel la coordination au niveau national. Des dispositions spécifiques devraient être insérées dans la législation nationale afin de couvrir le rapatriement de la diversité biologique nationale qui a été rassemblée et emmenée par les puissances du Nord avant l'entrée en vigueur de la CDB. Il convient enfin d'encourager la coopération régionale dans l'application des lois et notamment dans la répression des mouvements transfrontières illégaux de materiaux génétiques.

PSAMMOMYS OBESUS, A DESERT GERBILLINAE RODENT

By

THÉRÈSE GERNIGON-SPYCHALOWICZ

Laboratoire d'Endocrinologie - I.S.N. - U.S.T.HB. - BP 39 - 16111 El Alia (Algérie)

Rodents living in arid zones constitute, due to the rigorous climate with which they must cope, good models of experimentation permitting to better understand the mechanisms of adaptation to a desert environment.

Classification

The study is based on a diurnal Saharan rodent, the Sand Rat Psammomys obesus (Cretzschmar, 1828) of the Gerbillinae family (Alston, 1816), super family Muroidae, which feeds exclusively on Chenopodiaceae, some members of which are very salty plants. Synonymous names (Le Berre, 1990 and Kowalski and Rzebik-Kowalska, 1991) are: Gerbillus robustus (Loche, 1978), Psammomys roudaleri (Lataste, 1881), Psammomys algericus (Thomas, 1902; Foley, 1929; Heim de Balzac, 1934; Allen, 1939), Psammomys algericus edusa (Thomas 1925; Allen, 1939), and Psammomys obesus obesus (Cretzchmar 1828; Allen, 1939; Niethammer, 1963).

Distribution

This animal is found throughout the Sahara: from the northern limits of the palm tree, to the south into Mauritania and the Sudan and eastward as far as Palestine and Arabia (Petter, 1961).

Place of Study

It is in the Algerian Sahara in the region of Béni-Abbès (30o7 latitude North and 2o10 longitude West at about 500m altitude) that we have regularly observed it. At Béni-Abbès, the formation of desert characteristics are specific and well defined: Western Erg (sand dunes), Saoura Wadi or river valley, Guir Hamada or plateau, the Djebel or mountain chain of the Ougarta formed of sandstone and clay from the Palaeozoic period. A research center created in 1942 enables basic experiments to take place in situ.

The climate is desertic hot and is characterized by episodic precipitation, extreme temperatures, intensive evaporation and maximum sunshine. The coldest month is January (average minimal temperature 5,03± 1,16oC, average maximal temperature 17,23± 1,79oC). The hottest months are July - August with average minimal temperatures of 28,68± 0,8oC and 29,01± 0,6oC and maximal average of 42,02± 1,07oC and 41,88± 0,51oC.

The range of the daily temperatures is great. Precipitation is rare, with a wide variation from one year to the next and taking place in the spring and especially in autumn (12,8 mm average October rainfall from 1985 to 1991 with a total absence of rain in October 1990). The relative humidity varies from 54% in winter to 15% in summer. The photo-period is from 9 hr in winter to 14 hours in summer.

It is always in the wadis where the Chenopodiaceae grow that the animals are observed : at Igli, in the Zousfana Wadi (places called Taouerta and Hassi Mahzene) and in the Saoura Wadi (Hassi Boumane, Akacha, Harrez), at Zguilma (Djorf El Mehaba) and closer to Beni-Abbès again in the Saoura Wadi at Hedeb Baba Aïda, Marhouma et B'Chir.

Description

This rodent, the size of a rat (total head-body length, 130-160 mm) with reddish-brown fur, tiny ears, has a long tail ending with a tuft of brown-black hair. The incisors and molars are smooth. Adult body weight varies from 80 to 120g in zones where the vegetation is sparse (Igli, Marhouma, B'chir). Adult body weight is more than 125g in zones where the vegetation is abundant (Abadla).

DIET

The range of the Sand Rat is related to the hydrographic system; the Psammomys live in the wadi beds, in sandy or clay depressions of the ravines or at the foot of cliffs where the vegetation is abundant (Petter, 1961; Ranck, 1968; Petter, 1975).

In the wadi beds, the Sand Rat digs its burrow under the clumps of Chenopodiaceae, halophyte plants very rich in water (ca. 80%) and in minerals, flourishing in autumn or spring and constituting its only food. Generally, the burrows are dug under Traganum nudatum "damran" a bushy plant with small pale green ovoid leaves, Suaeda mollis "souid" plant which blackens and was used to dye clothing black, Salsola foetida "rcel" with short grayish soft leaves that give off a fetid odour when rubbed or Atriplex halimus "gtaf" eaten as a salad or used as medication. The Sand Rat will exploit a bush untill it's finished, abandon it and return when the bush has renewed itself. The Sand Rat climbs the bush easily, bites off the ends with its incisors and stacks what has been cut. At the end of 3 to 6 "climbs", it stores what it has gathered in its burrow (Daly and Daly, 1973). Its keen hearing permits it to take refuge in the burrow, the Sand Rat listens for a long time, heedful of the least sound before coming out to search for food (personal observations).

BURROW

The burrow is comprised of several levels of galleries from 4 to 6 cm in diameter, with communication between them by secondary galleries with 4 or 6 access holes. Inside are 3 rooms: one is the nest with fine grasses; another serves as storage; the third is the latrine, the animal caring for order and cleanliness (Choumowitch, 1954). The relative humidity is high (60 to 70%), with a constant temperature of 25oC (Petter, 1961). The females' domains are relatively small and exclusive while those of the male are spread out, often overlapping. Normally, each adult lives alone. The extreme agressiveness between those of the same species may be explained by the lack of diversity of food sources (Daly and Daly, 1975).

HABITS

The animal is diurnal and leaves its burrow at sunrise. In summer, foraging is limited to the cool hours of the day (dawn and dusk). Certain openings of the burrow are under the plant itself allowing the animal to exit the burrow and still be protected from the sun. In winter, expeditions take place later during the warmest hours of the day. The animal feeds on the spot or goes from one clump to another. Its outings are not limited to food gathering : the Sand Rat basks in the sun in front of its burrow or, sitting up, courts a female by emitting gurgles (personal observation) called "nuptial music" by Choumowitch (1954).

Its predators are the Horned Viper, the Fennec and birds of prey.

REPRODUCTION

The reproduction period spreads from September to May with numerous births in November and March. According to Choumowitch (1954), the gestation period lasts 25 days. There are several litters annually each with 2 to 5 offspring (Kowalski and Rzebik-Kowalska, 1991). They weigh 4g at birth and do not open their eyes before the 16th day. They are adults at 63 days and are, therefore, independent by summer. Longevity is about three years.

BREEDING

For successful breeding it is essential that male animals be isolated, warm (T=25oC), have sufficient space, clean sand or sawdust, and a shelter (Chirvan-Nia and Ratsimamanga, 1973). Psammomys obesus can be considered as the most difficult of Saharan rodents to breed (Petter, 1961). Sufficient quantities of fresh Chenopodiaceae branches must be brought each day: a female observed by Petter consumed 67 to 88% of its weight in 24 hours, the male 32 to 61% of its weight. In two days, a Psammomys must take in a quantity of food superior to its own body weight. This diurnal animal depends on sunlight; in a dark cage, the animal rapidly loses its tail due to Vitamin D deficiency (Choumowitch, 1954). Once accustomed to its surroundings, it comes out of its shelter and waiting for its food sometimes sits up.

Raised on the standard diet of the laboratory rats Psammomys becomes diabetic (Schmidt-Nielsen et al., 1964), thus serving not only as an excellent study model for diabetes but also the adaptation of the sand rat to life in an arid environment (Amirat et al. 1988, Khammar and Brudieux 1984, Gernigon et al. 1994).

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Saharian Rodents Video Commenatry

By
THÉRÈSE GERNIGON-SPYCHALOWICZ
Laboratoire d'Endocrinologie, I.S.N., U.S.T.H.B., B.P.39 El Alia, 16111 Algeria.

Psammomys obesus, the sand rat, lives in the region of Béni-Abbès (30o7 North and 2o10 West) in the Algerian Sahara. The desert climate is hot and characterised by occasional rain, rapid evaporation, maximum sunlight and a significant difference between night and day time temperatures.

The sand rat lives in the wadi beds and alluvial plains and digs its burrow under the Chenopodiaceae bushes, halophytes rich in water (80%) and mineral salts much higher than sea water. these plants which flower in autumn or spring are the sole food source: Traganum nudatum or "damran", a water-rich plant with small oval shaped pale green leaves, Atriplex halimus or "gtaf", Suaeda mollis or "souid" and Salsola foetida or "rcel".

The burrow is made up of a number of different levels of galleries about 4-6 cm in diameter, connected to each other by numerous secondary galleries. There may be 4-6 entrances to these burrows. In the deepest part of the burrows, the temperature remains constant at 25o C with a moisture level of 60-70% (Petter, 1961).

The females live in relatively small and secluded areas; the males cover a wider territory which they guard jealously ... a practice partly explained by the scarcity of food supply.

Before leaving the burrow, the sand rat listens attentively for a long time, its ears finely tuned to the least noise. With its incisors, the sand rat bites off the fresh green tips of the plant. It will either eat them immediatly or stock them up and carry them back to the burrow. This salt-rich plant is the rat's sole food in the desert; if this strict diet is changed under laboratory conditions, the sand rat becomes diabetic (Schmidt-Nielsen et al., 1964).

The sand rat leaves its burrow only in the day time: in summer, in the morning or late afternoon, and shelters in the midday heat in its burrow or under the sparse vegetation; in winter, the sand rat waits until later in the day when the sun has thoroughly warmed the wadi.

The trapper must look for fresh traces of the sand in order to determine if the burrow is inhabited or not. as the sand rat is often victim to fennec, vipers and other predators. Preparation of the traps begins with gathering fresh Chenopodiaceae, the smell of which attracts the sand rat. Thus the trap must be put in position before the rat's first food-gathering expedition of the day. The trap is placed in front of the main entrance of the burrow, and all other exits are sealed off.

The captured animals are raised in the laboratory at Béni-Abbès. This rodent is the size of a rat with a fawny brown coat, has small ears and a long tail ending in a black tuft of fur. Its incisors and molars are smooth. Body weight of the adult varies from 0 to 120g in areas of sparse vegetation (e.g. Igli, Marhouma, B'chir) to more than 125g in areas of richer vegetation (Abadla).

To survive in captivity, it is imperative that each male be isolated, live in a constant temperature of 25oC, have sufficient room to range on sand or clean sawdust and shelter. Fresh Chenopodiaceae must be picked each day in sufficient quantity. A female, observed by Petter (1961) consumed 67-88% of her body weight. The sand rat also needs sunlight: in a dark room, the animal loses its tail quickly because of vitamin D deficiency. The sand rat likes a clean habitat and in captivity the sand or sawdust must be changed every day. Once familiar with its new surroundings, it will adjust to new feeding times, even posing for the occasion!

The reproductive activity of the sand rat extends from September to May with many births in November and March, with gestation between 25 days (Dehne, 1914) and 36 days (Choumovitch, 1954). There may be several litters a year in multiple births of 2-5 offspring. The sand rat reaches

maturity in 63 days and is thus autonomous by summer. Life span is about 3 years.

The silky jird is another Gerbillidae which lives on the desert plateaus in the region of Béni-Abbès.

On these hammadas, the silky jird digs its burrow in the dayas or graras, the circular depressions on the ground where wind-blown sand and the occasional water supply encourage the growth of bushy vegetation. This hamada vegetation, studied by Petter (1953) consists of Papilionaceae, Compositae and the occasional Rhamnaceae.

The burrow of the silky jird is not as that of rat. Hence the moisture level is lower than in the burrow of the sand rat, reaching a maximum of 50%. Dug under a bush, the burrow often extends beyond the roots of the host plant.

The silky jird is herbivorous and likes a varied diet: fresh grains or green or dried plants. Thus the amount of water in this diet is difficult to detemine.

The silky jird is largely a nocturnal animal. Hence it is only in the evening that one looks for traces of the animal around its burrow. Traps are set at nightfale before the jird's nightly forays. Roasted barley or dates are used as bait. the following day, the traps are inspected at daybreak, because the trapped animals may be in danger of death, after the cold of night.

The silky jird is easy to raise in captivity because it is not as fussy as the sand rat with regard to its habitat: sawdust or straw may be used in place of sand. It likes a varied diet without water: e.g. grains such as wheat or barley, oats, fruits or green plants.

The silky jird is a tawny fawn colour with a white underside. The tail, also fawny coloured is reddish-brown near the body and ends in a black tuft. the toenails are always white in Meriones crassus and green in Meriones libycus. Its ears are not coloured. It has protruding eyes and a muzzle which is smaller than that of the sand rat.

The silky jird has an amazing memory, being able to find its way back to its nest from a 2 km radius. Young silky jird are born in the spring.

The comparison of these two desert rodents, diurnal and nocturnal, living in the same region but portraying contrasting life-styles can provide a fascinating study. It is a good way to study the role played by the photoperiod and temperature in the biochemical, metabolic and cytologic variations in reproduction.

The lesser gerbil (*Gerbillus gerbillus*) is a desert rodent about the size of a mouse and with a long tail.

It is found from the western Sahara to as far as Palestine.

It is an animal that must live in the sand. It digs its burrow in stable sand dunes, abandoned palm groves, thus assuring a favourable microclimate by day.

The lesser gerbil is a nocturnal animal, and while away from its burrow the entrance is left open so that the animal can make quik trips to and fro for gathering food.

Its diet is varied, like that of the silky jird, i.e. green plants, dates and grains.

The reproductive period is also observed during the spring.

Thomas's gundi (Ctenodactylus wali) is a Saharan rodent, Ctenodactylidae, found in rocky areas, on mountains and plateaus.

It looks rather like a guinea-pig with a greyish-fawn coat. Its body is specially adapted to living in rocky conditions, and it can move quickly away from danger through very small cracks in the rock.

Like the sand rat, it is diurnal, its life-style linked to sunny conditions in which it likes to sun bathe. During the colder times of the day in winter, it shelters, insulated in the rock.

A herbivore, the gundi, eats a varied but strict vegetarian diet. It never drinks, and can thus survive on very dry food in difficult times.

It shares its habitat in the rock with herbivorous lizards. The females give birth once or twice a year; the first births late in February, early March, and the second late May, early June.

The gundi is well adapted physiologically to living in desert conditions. It is studied for its adaptations to lack of water.

Dynamique des Systèmes Agraires et Développement Durable des Zones Arides: Cas du Sud-Est Tunisien

By
NOUREDDINE NASR
Chercheur-Enseignant I.R.A., 3200 Tataouine, Tunisie

Introduction

D'après LE HOUEROU (1969), la végétation primitive de l'étage méditerranéen aride inférieur au début de notre ère devait comporter: Juniperus phoenicia (genévrier de Phénicie), Olea europea (olivier), Ceratonia siliqua (caroubier), Pinus halepensis (pin d'Alep) et peut-être Tetraclinis articulata (Thuya de berberie). Suites aux différentes guerres et invasions (surtout celles des Hilaliens), à l'important accroissement démographique et à la gestion irrationnelle des ressources naturelles qu'ont connu les régions arides de la Tunisie, les peuplements arborés ont disparu pour laisser la place à la végétation steppique actuelle. Cette steppe est caractérisée par un couvert végétal réduit, non diversifié, bas et à faible production. Parallèlement à la disparition de la flore, la faune sauvage de ces régions a connu une importante réduction voire même la disparition d'espèces dans certains secteurs. Avec les mutations socio-économiques que sont en train de connaître les régions arides tunisiennes, la végétation de la steppe ainsi que sa faune sont ménacées d'une disparition certaine. Pour anlyser les risues écologiques auxquels sont confrontées les zones arides nous présentons un constat de situation de la région du sud tunisien, considérée parmi les plus arides et les plus menacées par la désertification.

Mutation des Systemes Agraires en Zones Arides

La sédentarisation des populations nomades et semi nomades

Depuis son installation dans les régions du centre-sud du pays l'administration française s'est fixée comme objectif prioritaire la sédentarisation des populations nomades et semi-nomades et ce pour faciliter leur contrôle. Ainsi des oasis ont été créées dans le Nefzaoua et dans le J'rid pour accueillir les nomades (OULED HAMED, GHRIB, M'RAZIG, SABRIA, etc.) de ces régions pré-sahariennes. Des parcelles de 0,25 ha plantées en palmiers dattiers de variété "Deglet Ennour" ont été attribuées aux anciens nomades et semi-nomades dans les oasis de Jemna (1912), B'chilli (1935), El-Faouar (1949), etc. (NASR 1986).

Après l'indépendance du pays l"Etat tunisien a poursuivi la politique de création des oasis mono-variétale "Deglet Ennour" et la sédentarisation du reste de la population semi-nomade dans les oasis de Gasr Ghilaine, Borj El Khadhra et récemment Bechni, Rjim Maatoug, Matrouh et Ibn Chabbat.

Dans la région du sud-est de la Tunisie l'administration militaire française a crée des noyaux de sédentarisation vers lesquels ont été attirés, par différents moyens (attribution à titre privé de lots de construction de logements, écoles, dispensaires, etc.), les nomades et semi nomades OUERGHEMMA. C'est ainsi que les villes de Médenine, Bir Lahmar, Remada, S'mar, Ben Guerdane, etc. ont accueilli les nomades et semi nomades du sud-est tunisien. Puis depuis l'indépendance du pays d'importants

programmes de développement urbain et rural ont été entrepris par l'"Etat dans ces régions visant l'amélioration des conditions de vie et de production des populations (eau, électricité, écoles, lycées, routes, téléphone, etc.). En effet d'un espace pastoral, la steppe va devenir après la sédentarisation des nomades un lieu d'habitat et un espace agro-pastoral, agricole, commercial et industriel et devient une région d'accueil après avoir été pendant longtemps à solde migratoire négatif. Enfin, du début de ce siècle jusqu'à nos jours la population du pays est passée d'environ 1,5 à plus de 9 millions, et celle des zones steppiques a connu un accroissement similaire. Cette situation s'est traduite par une forte pression sur le milieu manifestée par l'apparition des auréoles de désertification autour des oasis et des villes et ce suite au surpâturage, au ramassage du bois de feu et au défrichement des terrains (céréaliculture, arboriculture, etc.).

La privastisation des terres collectives, le changement des modes d'élevage et la dégradation des parcours

Dès l'indépendance, l'Etat a entrepris de réformer les régimes fonciers traditionnels, ainsi le régime des "habous" a été aboli par les décrets de 1950 et de 1957 et environ 1 500 000 ha de terres "habous" ont été touchées par cette réforme. Après les terres "habous", les réformes se sont orientées vers les terres collectives. En effet, par la loi no 16 du 28/09/1957, les anciens textes relatifs aux terres collectives ont été refondus et adaptés aux conditions nouvelles de la Tunisie indépendante. La loi no 59-83 du 21/07/1959 a clarifié les procédures et les conditions d'octroi à titre privé des terres collectives: cette conversion touchera 1,5 (terres à vocation agricole attribuables) sur les 3 millions d'ha de terres collectives dont la majorité est située dans le centre-sud du pays. En 1991, 1 194 000 ha de terres à vocation agricole ont été attributées à titre privatif à des ayants-droits (ABAAB 1994). Ces terres soustraites aux parcours coonstituaient les meilleurs pâturage de la région. Cette transformation du statut foncier des terres s'est traduite par un rétrécissement des espaces pastoraux et par conséquent la concentration des troupeaux dans le restant des parcours constitués souvent de terrains parmi les plus ingrats de la région.

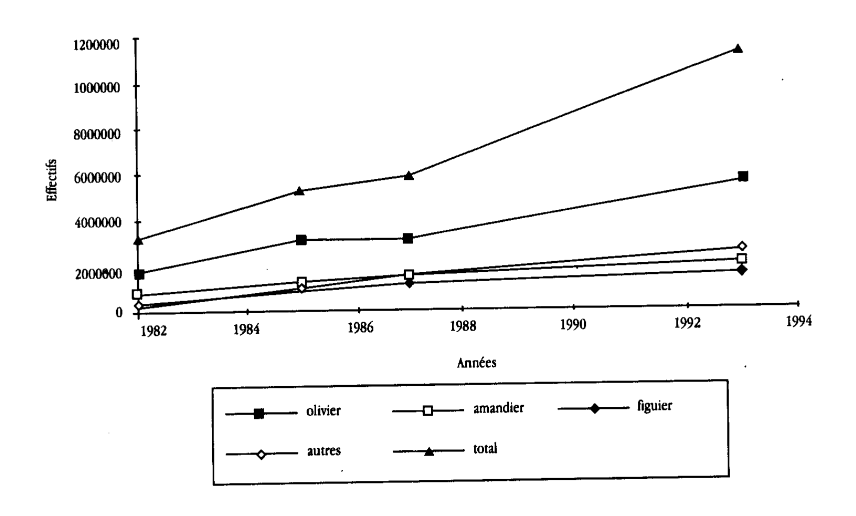
Parallèlement à cette situation, la supplémentation du cheptel avec des aliments largement subventionnés (surtout pendant la décennie des années 1970) a permis une intensification de l'élevage et un accroissement des effectifs, notamment du cheptel ovin. Cette politique va avoir, après l'abandon progressif des subventions, un impact négatif sur les milieux (surtout en zone aride) par suite d'une forte charge animale sur les parcours. En effet, la supplémentation a permis la sauvegarde du chaptel en mettant fin aux hécatombes qui décimaient une partie du troupeau ovin et caprin en années de disettes (1922-1923, 1927-1928, 1935, 1938, 1943, 1946-1948, etc.). Parallèlement à l'accroissement des effectifs des petits ruminants, l'élevage des camélidés a connu depuis la privatisation des anciens parcours collectifs, sédentarisation des populations nomades et semi-nomades, la généralisation de la mécanisation des travaux agricoles et l'augmentation du nombre de camions et surtout de camionnettes un recul considérable dans la steppe tunisienne.

L'extension des cultures et de la technique du dry-farming dans la steppe

Depuis le début de ce siècle et surtout après l'indépendance du pays d'importantes mutations socio-économiques vont toucher la steppe tunisienne. Ainsi, depuis le début de ce siècle jusqu'à nos jours plus de 2700 000 ha ont été soustraits aux parcours steppiques et mis en culture. Selon les travaux de LE HOUEROU (1969), les superficies occupées par l'arboriculture en Tunisie steppique se sont étendues d'environ 20 000 ha par an entre 1950 et 1969 (soit 400 000 ha en 20 ans). Cette dynamique de l'extension de l'arboriculture va s'intensifier à partir des années 1970 suite aux lois et décrets faciliant l'attribution à titre privé des terres collectives et aux différents programmes de développement agricole subventionnés par l'Etat. Les résultats apparents de cette politique agraire sont l'extension de l'arboriculture dans des régions qui étaient jusque là pastorales: Kairouan, Kasserine, Sidi Bouzid, Gafsa, Médenine, Tataouine, etc. Dans le Gouvernorat de Tataouine, région qui est restée jusqu'à ces dernières années marquée par l'importance des activités pastorales, l'arboriculture est en train de connaître une expansion extraordinaire. Traditionnellement limitée au jbel, dans les "jessour", l'arboriculture à Tataouine est en train de

connaître une importante extension dans le Dahar, dans la plaine de la Jefara et même dans certains secteurs d'El Ouara. Cette arboriculture se développe généralement sur les terres collectives attribuées à titre privé. Ainsi dans le Gouvernorat de Tataouine le patrimoine arboricole a évolué entre 1982 et 1993 de 298 650 arbres à 1 107 933 soit une augmentation annuelle moyenne d'environ 74 000 pieds. (cf, graphique no 1).

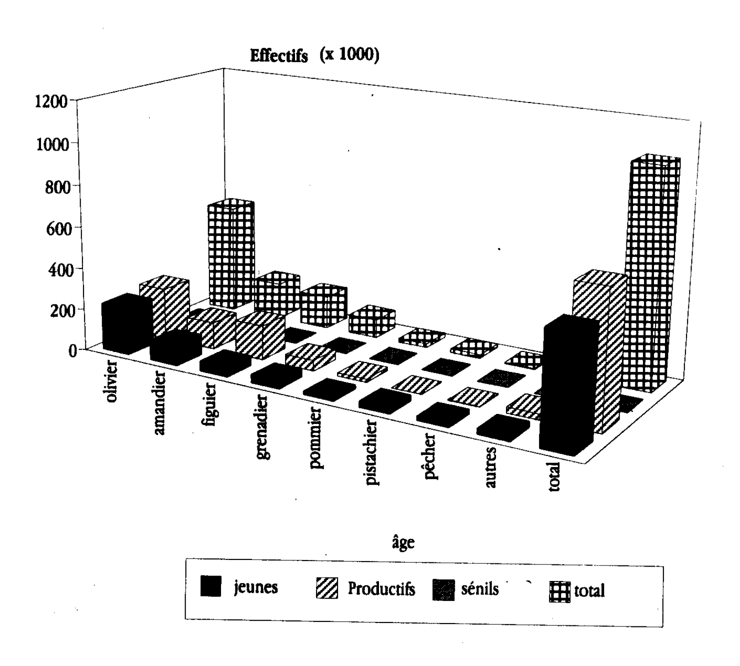
Graphique no 1: Extension des plantations arboricoles dans le Gouvernorat de Tataouine (1982-1993)



Source: Rapports CRDA Tataouine
et CRDA-IRA, 1994.

L'extension des plantations arboricoles s'est accompagnée d'une part par la sortie de l'olivier de son aire agro-écologique traditionnel (jbel) pour envahir le plateau (Dahar) et la plaine (Jefara et El-Ouara) et d'autre part par la diversification des espèces arboricoles (cf, graphique no 2). En effet, les espèces autres que l'olivier, l'amandier et le figuier (espèces "traditionnelles" dans la région) représentent en 1993 environ 21,5% du partimoine arboricole contre seulement 8,8% en 1982.

Graphique no 2: L'arboriculture par espèce dans le Gouvernorat de Tatouine (campagne agricole 1993-1994)



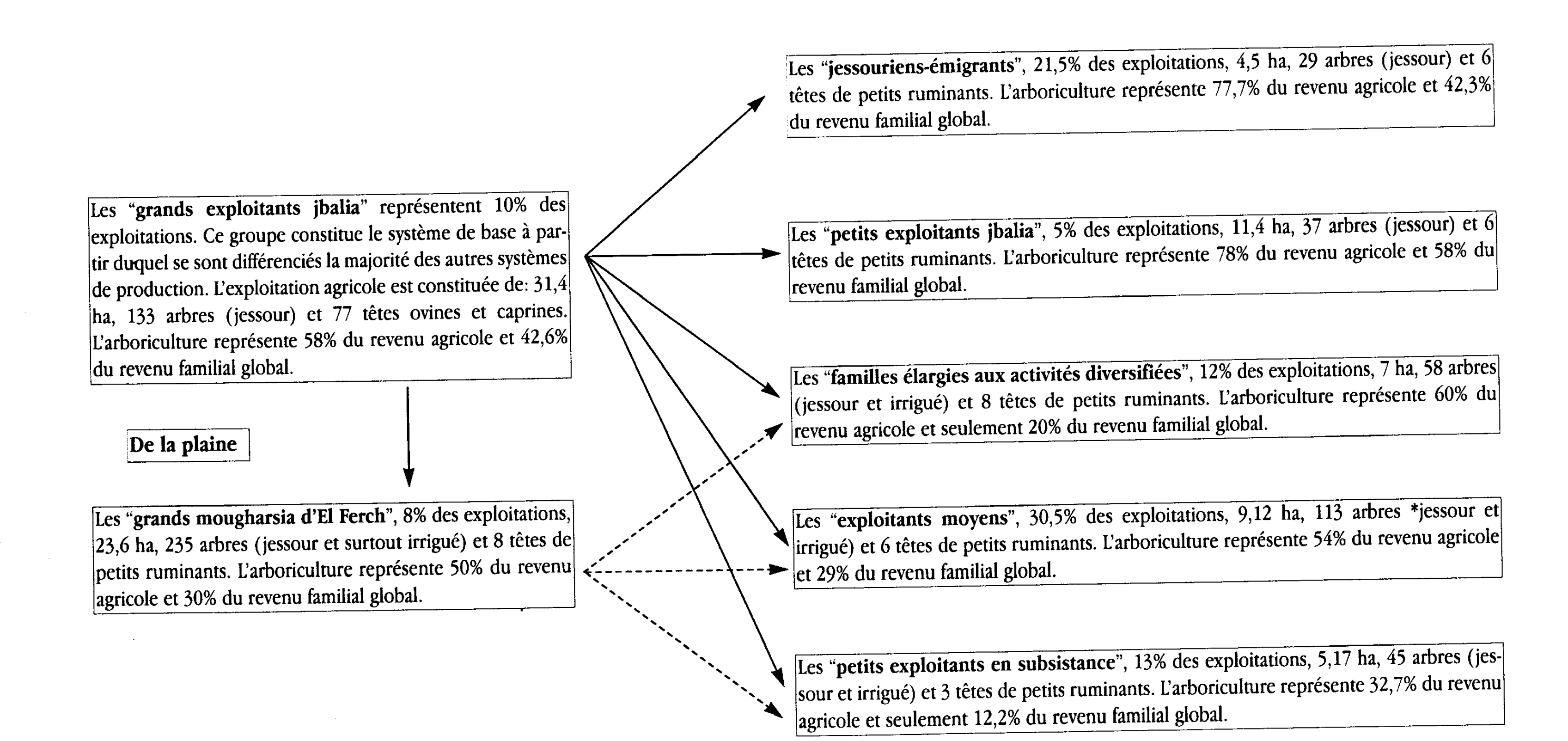
Source: IRA-CRDA Tataouine; 1994.

Pour assurer la réussite des plantations oléicoles dans la plaine de la Jefara et d' El-Ouara les agro-pasteurs appliquent la technique du dry-farming. Très répandue dans la région sfaxienne, cette technique consiste à pratiquer au moins quatre façons superficielles par an avec des déchaumeuses à dents ou à disques. Dans la Jefara, où les sols sont particulièrement fragiles, l'utilisation du polydisques s'est traduite par la dégradation du milieu et par la formation de dunes mobiles dans les oliveraies. Aussi l'emploi du polydisques pour la céréaliculture qui a connu une importante extension suite à généralisation de la mécanisation, a provoqué la dégradation de la steppe et a accentué la désertification dans certains secteurs.

La diversification des systèmes de production

Les mutations socio-économiques survenues dans les régions arides du sud-est tunisien se sont traduites par la diversification des systèmes de production agricole et le changement du mode d'occupation et d'exploitation du milieu. L'étude des systèmes de production dans les zones steppiques a permis de constater la disparition des anciens systèmes pastoraux et l'émergence de nouveaux systèmes de production agricole et agro-pastorale. Ces nouveaux systèmes de production sont généralement plus intensifs (eau, travail, mécanisation, nouvelles cultures, nouvelles variétés, importants capitaux, etc.) et visent la commercialisation voire même l'exportation des produits agricoles. Cette nouvelle dynamique dans les zones arides s'est traduite certes par une amélioration des conditions de vie et de production des populations mais dans le même temps a provoqué une forte pression sur un milieu fragile. En effet les noveaux systèmes de production qui se développent dans les secteurs du jbels (cf, graphique no 1) tendent vers une gestion irrationnelle des ressources naturelles. Aussi les systèmes de production de la plaine, après avoir été pendant plusieurs siècles basés sur le pastoralisme sont devenus à dominante arboricole (cf, graphique no 2).

Graphique n° 3: Dynamique des systèmes de production en zones arides: les systèmes "Jbalia" de Tatouine. (NASR 1993)



Graphique n° 4: Dynamique des systèmes pastoraux en zones arides: La Jefara tunisienne: Imada de Neffatia

Le système des "**pasteurs reliques**" représente 8,5% des exploitations. Ce groupe constitue le système "traditionnel" de la Jefara tunisienne. C'est à partir de ce groupe que se sont différenciés les autres systèmes de production. L'exploitation agricole de ce système est constituée 106 ha (importance des terres collectives), 119 têtes ovires et caprines (pratique la transhumance) et 118 arbres dont 90% sont jeunes. La production végétale représente 25% du revenu global de la famille. L'activité non agricole n'est pas importante (9% du revenu global).

Le système des "**eleveurs moyens**" représente 9,6% des exploitations. L'exploitation est constituée de 43 ha (beaucoup de mougharsa), 51 têtes ovines et caprines (pratique de la transhumance), 255 arbres dont seulement 50% sont productifs. La productions végetale représente le 1/4 du revenu global de la famille. Les revenus extra-agricoles sont importants (41% du revenu global).

Les système des "**grands exploitants**" représente 5,3% des exploitations. L'exploitation agricole de ce système est constituée de 194 ha (importance des terres privatives), 150 têtes ovines et caprines (intégration agriculture—élevage car 80% des oliviers sont productifs). La production végétale représente 21% du revenu familial. L'activité non agricole est importante et représente 23% du revenu global.

Le système des "**grands arboriculteurs**" représente 4,2% des exploitations. L'exploitation agricole est constituée de 65 ha (achat de terrains et beaucoup de mougharsa), 39 têtes ovines et caprines (intégré à l'exploitation) et 644 arbres dont 59% sont des oliviers. La production végétale représente 29% du revenu familial global. Les revenus non agricoles sont importants et représentent 45% du revenu global.

Le système des "**arboriculteurs émigrants**" représente 13,8% des exploitations. L'exploitation agricole de ce système est constituée de 24 ha (le 1/5 de la superficie est achetée ou acquise par mougharsa), 17 têtes ovines et caprines et 569 arbres dont les 2/3 sont jeunes. La production végétale représente le 1/3 du revenu familial global. Le revenu extra-agricole est important (émigration surtout) et représente la moitié du revenu familial global.

Le système des "**producteurs marginaux**" représente 46% des exploitations. L'exploitation agricole de ce système est constituée de 8 ha (importance de la pratique de la mougharsa et l'achat de terrain), 11 têtes ovines et caprines et 107 arabres dont les 2/3 sont jeunes et non encore productifs. La production végétale représente 21% du revenu familial qui est constitué surtout de revenu non agricole (60,5%).

Le système des "**petits agriculteurs-éleveurs**" représente 12,8% des exploitations. L'exploitation agricole de ce système est constituée de 25 ha (pratique de la mougharsa pour accéder à la propriété), de 19 têtes ovines et caprines et 168 arbres dont 46% sont jeunes. La production végétale représente 27% du revenu familial global. Les activités non agricoles sont importantes (46,5% du revenu global).

Adapté de NASR, ABAAB et BEN ABEDM, 1992

UNE FAUNE ET UNE FLORE MENACEES

L'ensemble des mutations socio-économiques survenues dans la région du sud-est la Tunisie (sédentarisation des pasteurs nomades, accroissement démorgraphique, privastisation des terres collectives, extension de l'oléiculture, diversification des activités agricoles et non agricoles, etc.) se sont traduites par un recul de l'élevage des camélidés. Pour l'ensemble du pays, le troupeau camelin est ainsi passé d'environ 225 000 têtes en 1955 (ISMAIL 1990) à 65 000 têtes en 1991 (OEP 1991) et ce malgré les programmes nationaux de réhabilitation de ce type d'élevage dans le centre-sud du pays. Cet animal rustique et bien adapté aux conditions des zones arides est le seul à pouvoir valoriser les parcours des sebkhas. Son absence peut provoquer l'envahissement des parcours par des espèces non palatables par les petits ruminants.

La nouvelle occupation et exploitation, par l'homme, des anciens espaces pastoraux du centre-sud du pays s'est traduite par un refoulement de la faune sauvage vers les secteurs les plus éloignés et les plus difficiles. La gazelle dont les effectifs ont fortement chuté ces dernières années est le principal animal menacé par cette nouvelle dynamique dans la région du sud tunisien.

DISPARITION DU COUVERT VÉGÉTAL

L'extension de l'arboriculture et de la céréalicuture et la généralisation de la technique du dry-farming dans les olivesraies ont provoqué la disparition des plantes pastorales annuelles et surtout vivaces dans les terrains mis en culture. La dégradation de steppe par l'effet du surpâturage et surtout par le défrichement pour la céréaliculture constitue des situations souvent irréversibles pour la reconstitution de la végétation. A titre d'exemple la reconstitution d'une steppe d'Artemisia herba-alba ne peut se faire sans qu'il y ait présence de semenciers (TELAHIGUE 1981). Les travaux de FLORET, LE FLOC'H et PONTANNIER dans le sud de la Tunisie ont démontré le danger de la mécanisation sur la biodiversité dans les steppes à Rhantherium suaveolens.

Tableau no 1:
Influence de la culture et du mode de défrichement sur la végétation de la steppe à Rhanterium suaveolens (d'après FLORET et al, 1977 in WAECHTER 1985)

	Couvert végétal (%)	Couvert de la céréale (%)	Couvert du Rhante ritum (%)	Nombre d'espèces spontanées
Steppe pâturée	25	0	17	39
Steppe défrichée à l'araire traditionnel (pour céréale)	11	0,7	7	25
Steppe défrichée à la charrue à disques (pour céréale)	5	0,5	2	13

NEFFATI a souligné dans ces différents travaux (1984, 1988, 1989 et 1991) l'envahissement et la colonisation des parcours de la Jefara tunisienne par l'Artemisia campestris espèce non palatable. Auss CHAIEB (1985), AKRIMI et al, (1988, 19889 et 1991) ont souligné la raréfaction des bonnes espèces pastorales et de certains arbustes dans les parcours du sud-est tunisien: Cenchrus ciliaris, Periploca laevigata, Rhus tripartitum.

CONCLUSION

Conscient du problème de la dégradation des écosystèmes des zones arides et semi arides, l'Etat a entrepris une politique de protection de l'environnement et de réhabilitation des milieux dégradés. Des parcs protégés visant la protection de la faune et de la flore ont été créés par la Direction des Forêts dans le centre et le sud du pays: Orbat, Bou Hedma, Sidi Toui (El Ouara) et bientôt celui de Aïn Dkouk à Tataouine. La même Direction crée et gère des réserves pastorales dans le centre-sud du pays. Dans le même cadre, l'Office de l'Elevage et des Pâturages, réalise un programme d'amélioration pastorale: mise en défens, plantation d'arbustes fourragers, etc., dans les parcelles privées chez les agro-pasteurs intéressés. Parallèlement aux programmes de développement, des actions de recherche visant la stabilisation de l'équilibre écologique des zones arides sont conduites par différents organismes de formation et de recherche. Généralement, la recherche en matière de réhabilitation du couvert végétal dans ces zones, intéresse les espèces autochtones qui ont l'avantage d'être plus adaptées aux conditions écologiques des zones arides. Une douzaine d'espèces pastorales exotiques dont certaines sont menacées de disparition ont été étudiées à l'Institut des Régions Arides de Médenine (IRA) et des semences sont collectées dans les parcours et stockées dans une banque de semences à l'IRA. Parmi ces espèces citons surtout: Stipagrostis pungens, Cenchrus ciliaris, Stipa lagascae, Lotus creticus, Retama raetam, Rhanterium suaveolens, Periploca laevigata. Rhus tripartitum (AKRIMI et NEFFATI 1991). Dans le même programme de recherche l'Institut National de Recherches Forestières (INRF) a entrepris une action pour la sauvegarde des ressources phytogénétiques arborées et arbustives des zones arides et étudiées parmi lesquelles citons surtout: Pistacia atlantica, Calligonum sp., Acacia tortillis, Periploca laevigata, Rhus tripartitum, etc. (KHOUJA 1988 et 1989).

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An Overview of Biodiversity of Libyan Ecosystems

By
H. A. MAGHRABI AND A. A. ABUFAYED

Introduction

Libya is a vast expanse of semi-arid desert of variable topography located in North Africa. It is bounded by the Mediterranean Sea to the north, Egypt to the east, the Sudan to the south east, Niger and Chad to the south, and Tunisia and Algeria to the west. Libya covers an area of 1,748,7002 km of primarily desert terrain and is divisible into three provinces, the Cyrenaica encompasses the entire eastern part of Libya; the Tripolitania, includes the eastern; and Fezzan at the southern quadrants. The strategic locations of Libya in North Africa, its unique landscape features, including the geology, vegetation and life, and climate reflect the ecosystems diversity and biodiversity of this region of the world. Exploration of Libya dates from the end of the 18th century, but data accumulation began only in the middle of the 19th century.

The main objective of this study is to explore the biodiversity of Libyan ecosystems through the literature available, museums; zoos and national parks; personal collections and observations. It is believed that the information obtained will fill a large gap in information concerning this part of North Africa.

A second objective is to highlight the trends and influence on the Libyan ecosystems resulting from natural and man-made activities so that well based conservation strategies and plans are developed.

Physical Features

Libya is divisible into several rather distinctive physiographic elements, namely: the coastal plain which varies in width from a few hundred meters in northern Cyrenaica to 50-60 km in north western Tripolitania. Wadis and sand dunes cause local irregularities in the surface of this plain. Tawurgha, Benghazi plain and Zwarah are the principal salt lakes in the region.

The coastal escarpment separating the coastal plain from the higher desert to the interior varies in elevation as well. Cyrenaican Plateau and Gebel Nefusa are typical examples. Pre-Saharan or Steppe is a broad area located between the Mediterranean littoral and the truly Saharan desert of the interior. The steppe are frequently dissected by numerous dry water courses which drain into the Mediterranean, such as Wadi Soffegin. Further south these areas form the region of Hamada el Hamra and Idehan Murzuch and the vast sand sea of eastern Cyrenaica.

The hamada desert is a distinct physiographic type of gravel plains. Hamade el Hamra and the hamada of Gebel el Harug el Sued are examples. Sand seas are the most dominant features of the Sahara; sand seas of east-central Cyrenica, Rebianuma and Idehan of Murzuch are representative examples. Sand dunes vary in size, shape, stability and firmness.

Serirs are extensive bed rock areas covered with a veneer of sand and gravel of varying depth and heterogeneity. Serirs of central Cyrenaica and Tibesti typify this physiological type.

Depressions of Giarabub Oasis, Gido, Bahr el Tubat, and Qattera are physiographically distinct from surrounding terrain. Most of these depressions have salt marshes and saline lakes of considerable size such as those of Tazerbo, Kufra. Mountainous areas of the interior are scattered throughout Libya. Volcanic mountains are Gebel es Suda and el Harug el Sued of Central Libya. Acaus, Uweinat and Tibesti are mountain complexes of Libya interior.

The Cyrenaica Plateau is characterized by high rolling slopes and deep canyons, differs strikingly from all other physical features of Libya. The highest point in the plateau is 882 meters above sea level. Some areas of the plateau are almost flat and allow sizable agricultural endeavours. The Barce Valley in western part of the plateau is a basinof the internal drainage and is unique in Libya in this respect. During periods of unusually high rainfall, fresh water accumulates in the bottom of the valley to a depth of several meters and thus forms a rather sizable lake.

The Tripolitania Gebel (Gebel Nefusa) is less clearly defined by discrete physical elements. The highest point in the Gebel, 98 meters, is located between Gharian and Beniwalid. Wadi Caam and Wadi Soffegin originate in the interior of Tripolitanian Gebel.

CLIMATE

The climatic subdivisions of the Libyan interior can be recognized. First, the arid, or desert type, the true Saharan portions of Libya in which rainfall is always meager and extremely variable from year to year. Some parts of Fezzan receive no rainfall at all, sometimes extending over many years. Skies are most frequently clear in Libya; and relative humidity is almost always low in the Sahara interior (12-13%). Dry air, cloudless skies, dry earth, which produce relatively large temperatures are also responsible for producing marked temperature variations with 24 hour period.

During summer intense diurnal heat prevails . In the northern Sahara average daily maxima and minima are 37 Co to 22 Co. The highest air temperature (58 Co) ever recorded was that recorded in El-Azizia south of Tripoli. During winter, the daily maxima average 15.5 Co to 22 Co. The Saharan portion of Libya tends to be windy owing to the lack of obstructions of moving air by sparse vegetation cover.

Second, semi arid or steppe type, is a region of low latitude steppe climate. The areas are subjected to brief periods of winter, rain bearing winds and their associated storms, which cause them to be semiarid rather than arid. The steppe has almost all of its rain in the winter, the yearly total is 30 mm. The amount of precipitation varies from year to year, from a recorded high of 60.7 mm. to a low of 17 mm. Because rainfall is in showers of comparatively short duration, the weather is prevailingly sunny.

Mediterranean Littoral: most portions of coastal Libya have a Mediterranean sub tropical climate. Winter months have average temperatures between 4.5 Co and 10 Co. Summer month temperatures are 22 Co to 30 Co and mean annual ranges of -1 Co to 4.5 Co are common. On coastal plain, rainfall generally approaches 1 to 25 inches, and pronounced summer drought. If this amount of rain fell during the hot summers when evaporation is high, semiarid conditions would result.

A peculiarity of the climate of northern Tripolitania is the "Gibli", a hot desert wind can cause a temperature rise of 6.5 Co to -1 Co in both summer and winter. The "Giblis" raise the temperatures of the coasal plain well above 43 Co, and for several days carrying large quantities of dust into the coastal regions.

On the Cyrenaican Plateau and Tripolitania Gebel, the summers are more moderate than those of coastal plain, and receive more rainfall than the surrounding areas. The Gebel Nefusa receives a yearly average of 37.5 to 50 mm. mainly during short winter period. The Cyrenaican Plateau has approximately 75 m. of rain distributed rather uniformly throughout the year.

FLORA

Pampanini (1931); Shaw (1931 and 1934); Rattary (1934); Zavattari (1934), Ozenda (1958), and many others revealed an extensive work on Libyan Flora. According to Ozenda (1958), the flora of North Africa, including the Sahara, comprises portions of two major Floral Empires: The Holarctic Flora Empire and the Paleotropical Floral Empire. Coastal Libya falls with the Mediterranean Floral Region, and the Saharan interior of Libya belongs to Saharo - Sindian Floral Region. Therefore, the flora of Libya, has most of its affinities with the Holarctic Floral Empire.

Ozenda (1958) characterized the phytogeography of the Saharo - Sindian Floral region, which

includes most of Libya. He pointed out to the great poverty of Saharan species (10,000 species), and listed 35 species of endemic vascular plants in the northern Sahara, many of which occur in Libya. In the northern Sahara, including the steppe and deserts of Libya, there are approximately 20 species of trees; mainly Ephedra, Cupressus, Phoenix, Ficus, Acacia, Pistacia, Tamarix, Calotropis, Olea, and Calligonum.

The flora of coastal plain varies according to soil types and upon the season. Generally the vegetative cover of the coastal plain is denuded by over grazing, but occasionally it is quite uniform. Examples of most typical genera of the coastal plain vegetative cover are Hyparrhenia, Cyperus, Pactium, Martimum, and Dactylis. Northern Tripolitania supports extensive groves of olives, date palms, vine yards, citrus, Eucalyptus, and Acacia. In comparison, the Gefara plain and northwestern Tripolitania vegetative cover is mainly shrub-steppe type of vegetation.

The Cyrenaican plateau vegetation consists of a variety of arborescent species, grasses and other herbaceous plants. Wadi el Kuf which is located in the Green Mountain supports occasional stands of Pinus, and Cupressus. In areas where agriculture is widespread, the grass cover is interrupted by open fields and cultivted areas.

In Tripolitania Gebel, the flora composition of Gebel Nefusa differs markedly from the Cyrenaican Plateau, and has greater affinities with the flora of Saharan Steppe. Stipa grass is the dominant species; other plants include Teucrium, Rhamnus, Olea, and Phoenix.

The semiarid region of the Sahara steppe is mainly of desert vegetation cover. Asphodelus, Artemisia, Aristida, Stipa, and Acacia are the major genera of the steppe.

Sand seas, Hamadas and Serirs cover many herbaceous plants. In sand seas the Aristida, Ephedra, Retama, Calligonum, Moltkia are most common. The hamada flora consists of several genera which include Haloxylon, Fagonia, Erodium, and Lifago. In the Serirs, sandy genera belong to genera of Aristida, Cornulaca, and Colocynthis.

Libyan depressions (Sebkhets) have a distinctive flora of salt-tolerant representatives of Chenopodiacea such as Salsola, Atriplex, Traganum, Cornulaca and Suaeda. In the vicinity of the Giarabub Oasis the well known salt-tolerant genera are the Chenopodium Arthrocnemum and Salsola. Along the margins of depressions tamariscs and date palms are sometimes abundant.

Oases are typified by their high water tables. The oases in the interior of Libya support lush flora entirely unlike that of other areas. Large groves of Phoenix dactylifera are the dominant vegetative feature of the oases. In large Oases such as Kufra, and Tazerbo small lakes (mostly saline) characterized by dense growths of sedges and other vegetations such as Polygonum, Erianthus, Juncus, and Typha are found. In Oasis of Brack, fresh water is abundant and supports dense growths of Phragmites. Oases of Wadi as Shiati, Murzuch, Traghen, Umm Al-Araneb, Mesgauin and Zuila are home to large groves of date palms. The development of large agriculural projects has created new agroecosystems in the region.

Further details on the grass cover of Libya may be found in an excellent review prepared by Rattray (1960).

Fauna

The Libyan fauna was reviewd by numerous scientists, authors, collectors, hunters, and military personnel. The exploring of Libyan fauna dates back to the end of the 17th century. Among these reviewers are: Hornemann (1797), Cella (1817), Lyonard (1820), Barth (1845), Dureyrier (1860), Rohlfs (1865). From 1880-1990 the major workers are Von Bary, Briceth, L'Alluand, Ascherson, Von Heiden, and Pirazzoli.

In the beginning of the 19th century zoological, taxonomical and ecological data on the Libyan fauna in different ecosystems have been added. Klaptoz (1906) studied the abundance and distribution of many different groups of Libyan fauna on the coastal plain. Studies of fauna Cyrenaica by I.T.O. (1909) were carried ont in respect to: Report on the work of the commission sent by the Jewish terri-

torial organization under the auspices of the Government of Tripoli to examine the territory proposed for the purpose of Jewish settlement in Cyrenaica.

The Italian occupation in 1911, started new zoological researches in the new colonial Libyan territory. Several specialists of agricultural, medical, economic and military have been involved in pest control in agroecosystems and public health programs.

In the begining of 1920 more studies and researches were conducted on the Libyan fauna not only on the coastal plain but also to the interior Sahara. Studies of Zanon (1915) Ghigi (1920), and I.T.C. (1920), illustrated a large work on the Libyan fauna. Kruger (1921-31) described 2210 insect species of his 14720 samples from Bengazi areas alone.

In the 1930's, Desio (1930) recorded an extensive work from Kufra, Giarabub, Şirti, Mrada and Augila-Galo. A large collection of these regional faunas were taken to Italian National History Museums in Milano, Genoa. Zanon (1930) on his hunting trip published his book "Fauna e Caccia nella Colonie Italiana". A great concern was applied to medical important species, their taxonomy, ecology epidemiology and control. Other authors include Graziani (1930), in his famous book "Verso il Fezzan"; Teruzzi, (1931) published "Cyrinaica Verde"; and Sillani (1932), "La Libya in venti anni di ocupazione Italiana". At last, Zavattari (1934) compiled in his publication "Prodormo Della Fauna Della Libya" a great deal of work on Libyan fauna since the end of 17th century.

From 1934 to present additional works have been added, but most of faunal data of repeated type, except of new species description or new localities. much work has been done in Entomology and Marine Science. Damiano (1961); Mellini (1952-1956); Ben Saad (1960) Pucci (1960); Fiori (1966); Kolkaila (1972); Hammad and Kolkaila (1973) covered many entomological areas. Other major faunal works, Setzer (1957), Naass (1987) and Mammer (1994).

The estimates of Libyan fauna from different ecosystems varies; but according to Ghigi (1912) the Libyan fauna was estimated to be 782 species. Zavattari (1934) reported that the total Libyan fauna includes more than 6000 species.

Today because of the social, eonomic, agricultural and industrial developments, new habitats and ecosystems have been created, which lead to great diversity and species richness of the fauna involved.

Three faunal areas, which coincide roughly with the major physiographic vegetative and climate features are recognized in Libya based on the distribution of different faunal groups. The faunal areas of Libya and their provinces are: The Mediterranean Faunal Area which is comprised of the coastal; Steppe Faunal Area consisting of the Transitional Desert Province and the Tripolitanian Gebel Province; and the Saharan Faunal Area which includes the Cyrenaican Province.

Libyan insects dominate different ecosystems: terestrial and fresh water habitats. Insects represent more than 50% of the total estimated Libyan fauna; almost 209 families and 3763 species since 1934. But few additional species have been identified. Twenty orders of insects were examined: the most common orders being Coleoptera (48 families, 406 genera and 1215 species); Lepidoptera (41 families, 396 genea and 913 species); Diptera (45 families, 277 genera and 520 species); Hymenoptera (19 families, 203 genera and 710 species); Orthoptera (16 families, 80 genera and 150 species); Hemiptera (16 families, 59 genera, and 75 species); Neuroptera (5 families, 33 genera and 75 species). Other orders were less represented.

Bird populations are estimated to be more than 44 families and 265 species. Additional species have been recorded. Since 1932-1970 23 bird species ring recoveries were made, originated mainly from Italy, Finland, Germany, Russia, Jugoslavia, France, Poland, Holland and Roumania. According to the African Conservation Convention, drawn by IUCN (1968) in Algiers, Libya among 38 other members, had signed the conservation convention. Accordingly, birds of prey, owls, all pelicans, herons, egrets and bitterns, vultures and flamingos have been protected by law.

Mammalian fauna represent major characteristics in their habitats from coastal to Saharan regions. More than 35 families and 640 species have been recorded. More genera, species and sub species were reported since 1934. Libyan rodents typified this type. Rank (1968), showed that Libyan rodents constitute 56 taxa comprising 7 families, 14 genera, 28 species and 48 subspecies. Mammals protected by

conservation law are: The Hyaena, Caracal, Lynx, Addax, Dorcas Gazelle, and Barbary sheep.

Based on molluscan collections, mainly from Tripolitana, about 22 families and 84 species were recorded. Today much is being applied along the coastal area. Terrestial molluscs as agricultural pests were studied. About 40 families and 170 species of arachnids have been identified from different ecological regions in Libya. Many of these species are of medical and agricultural importance.

Herpetological survey of Libya is estimated to be 13 families and 50 species. Amphbians are generally represented by three species. Reptiles mainly turtles, lizards and snakes. Schleich (1987) carried a herpetological survey in Kauf National Park and its adjacent areas (Jebel Akhdar). In 100,00 ha. park area 2 amphibians, 4 turtles, 12 lizards and 9 snake species were revealed.

Marine life was less represented in past years. However, much research is being conducted by Libyan scientists presently with its focus on taxonomical, ecological studies of marine fauna and flora. The Marine Biology Research Museum in Tripoli displays more than 48 families and 100 species of fishes; 15 families and 27 species of Bivalvia and 18 families and 50 species of Gastropods, in addition to other marine invertebrate fauna.

Future Trends and Influences

A basic conclusion from the previous presentation is that the Libyan ecosystems are very fragile because of the distinguishing physical features of the country. Thus they will be very susceptible to any changes in the local environment, no matter how small. The major factors influecing these ecosystems are summarized below along with expected trends in biodiversity.

Population dynamics

Although Libya's present population of about 4.2 million is not large by world standards, the effects of the rapid population growth, distribution, and structure may be considerable considering the Libyan ecosystem fragility. Population dynamics effects include:

- More land taken away for urban development including housing, transportation, recreation, etc. As most of the population resides in the arable coastal plains (rich ecosystems), the stresses on biodiversity will increase correspondingly. Deforestation, and taking over parks and protected areas are only a few potential problems.
- More resource utilization to meet the increase in demand. Utilization activities span practically all sectors including agriculture (food production), industry, energy, etc. and supporting services. Two by-products of this utilization are: 1) resource depletion and (2) pollution and waste generation. Both by-products will adversely affect biodiversity at a continually increasing rate.

Water supply and demand dynamics

Water is supplied mostly from groundwater reservoirs with less than 1% coming from surface sources (dams) and recycle and reuse. The major reservoirs containing most of the country's water are located in the south where less than 10% of the population resides. To correct this geopraphic imbalance between the supply and demand, the Great Man-Made River (GMMR) project is being executed to trasport water from the south to the north. The water will be used for domestic, industrial and agricultural purposes.The latter, in particular, shall have very significant effects on biodiversity as new agricultural settlements will be established, along with the infrastructure, irrigation systems, etc. The conversion of very arid or semiarid lands to farmland will certainly contribute to the biodiversity of these lands. Equally important, are the serious effects of the present day overdrought of groundwater reservoirs in the northern parts of the country. Depletion of the water and intrusion of seawater in the coastal areas have resulted in land degradation and salinization problems that are increasing at alarming rates with dire comsequences on biodiversity of the region.

Construction of the Pan Arab Coastal Railroad Network

Realizing the role transportation plays, in upgrading the economic and services levels in the country, Libya will construct a railroad network connecting the coastal cities on one hand and binding the country with its neighbours (Tunisia and Egypt) on the other. This network will, naturally, have measurable impacts on the coastal ecosystems as well as a result of the ensuing land transformation and the socioeconomic changes.

Socioeconomic Transformations

Changes in the standards of living over the last three decades have resulted in significant increases in rates and patterns of conosumption. Corresponding improvements in education have also had some effects though not to the desired levels. Subsequently, larger amounts of wastes are being generated thus posing a formidable challenge to waste mangement specialists especially in the municipal and industrial sectors.

Technology dynamics

The introduction of modern technology has extensive effects on ecosystems, especially in agriculture. Mechanized agriculture has converted many once desert lands into some land degradation problems accentuated by the overall dryness of the country and strong southern winds.

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Soil FAUNA Diversity in Arid Lands of North Africa

By
SAMIR I. GHABBOUR
Dept. of Natural Resources, Inst. of African Res. & Stud.,
Cairo University, 12613 Giza (Cairo), Egypt

The Palaeo-Environment

Recent research on the palaeo-environment in a region lying almost in the middle of the Sahara confirms once more that rainfall was much more than at present, even in latitudes far away from either the fringe of the Mediterranean or the Sahel. Thick deposits of palaeosols in the arid zones of North Africa, reach about 10 meters in depth in some places like the Messak Settafet in Libya (Lat. 26o N, Lon. 12o E). This is a recently explored small hill situated between the Ubari Sand Sea to the north and the Murzuk Sand Sea to the south, at about 720 km south of the city of Tripoli. Such deposits are typical of an equatorial forest with year-round precipitation that developed during a long period, most probably near the end of the Tertiary. Pleistocene hydrography was incised by rainfall much higher than at present. During the Holocene (at about 12 000 before present, or B.P.), these incisions were further deepened. Pedological conditions could favour a savanna vegetation that attracted Prehistoric human communities. Deep (more than 15 meters), fresh water, well-oxygenated palaeo-lakes existed at about 6 700 B.P. Their shores are associated with Neolithic age industries. An intra-Neolithic dry phase came about between the fifth and sixth millemium B.P. However, it is not proven that this phase was sufficiently intense to allow aeolian erosion. The really effective and final phase of aridity started in the Late Pleistocene, but engravings of large sized wild life continue into the Holocene, probably until the last lakes dried up (Cremaschi 1994).

Rock art does not of course provide a catalogue of the entire fauna that co-existed with Man, and of aquaticc animals only the hippopotamus and the crocodile are represented, together with a few fish (Van Albada and Van Albada 1994). The case of the Messak Settafet is not unique in the Sahara, the mountains of the whole region between the Saharan Atlas and the Sudan are "covered" by rock engravings and paintings of animals that could live in a favourable environment at about 8 000 years B.P. Between latitudes 16o and 26oN, in the massifs of the Iforas, the Hoggar, the Air, the Tassili, the Ténéré, the Fezzan, the Tibesti, and the Ennedi, were found either fossils or representations of the giraffe, the elephant, the African buffalo, the lion, the hippopotamus, and the rhinoceros, in addition to two extinct bovids (Allard-Huard 1994).

This brings us to the question of large scale animal extinctions associated with the dry climate ensuing in the Holocene. Was it limited to mammals, which are the most obvious because they are more easily fossilizable, and was it due to climate change, or to the "human meteorite"? Certainly the extinction of dinosaurs in the Mesozoic 70 million years ago cannot be blamed on humans, but that of Holocene mammals could be. In spite of the Holocene drought that came about into the Sahara, most mammal extinctions, strangely enough, did not happen in the Sahara, but in the present day temperate and cold expanses of Europe, northern Eurasia, and the two Americas. It is in these regions that the most brutal changes of biotopes occurred. Abrupt climatic oscillations between cold and warmth, and between drought and humidity, even for a period of 6000 years, between 16 000 and 10 000 B.P., with the concomitant changes in vegetation cover (steppe to forest and vice versa), were hardly favourable conditions allowing comfortable adaptation by the large mammals, especially those of open spaces. In the case of Africa, mass extinctions occurred in the Plio-Pleistocene interface, and more

importantly in the Villafranchian with two peaks between 1.5M and 1M years B.P., but most of these were in eastern and western Africa rather than in North Africa. In the Upper Pleistocene extinctions are rare in Africa, wherease there were no new immigrations into Africa from either Europe or Asia.

The thesis that climate change is the cause of mass mammalian extinctions of the Holocene and the Pleistocene before it, is not totally accepted. On the contrary, the climatic oscillations accelerated the speciation of new forms, among both herbivores and their predators. It may be however, that these climatic oscillations rendered ecosystems fragile, making them more vulnerable to other destructive factors. Such a factor was man, the "meteorite", by reference to the famous meteorite allegedly the cause of dinosaur extinctions. Man, as Homo sapiens, had acquired by the end of the Palaeolithic very efficacious arms amd means of hunting big game. Man would select for hunting the most profitable prey, those giving a worthwhile cost-benefit ratio, that is, bigger animals. Human impact on these animals would be greater the more difficult is their ecology and the less they are adapted to human predation: most adapted, because of a longer period of co-existence with humans, were the North African mammals. North Africa was also the region of least brutal climatic oscillations, compared to those regions which were covered by ice during the Ice Ages. This is perhaps why no extinctions of medium sized ungulates is documented in Africa, although they could have been preferred targets for hunters. Nevertheless, it appears that the last Glaciation, the Würm, was the harshest and the most abrupt of Glaciations, so that it appears that the role of humans was secondary to that of climatic change, being the principal causative agent (De La Marre 1994). In Africa, and in North Africa in particular, the responsibility of Man for mammalian mass extinctions is therefore even less than in temperate and cold regions of Europe.

In the Near East (the Fertile Crescent), very early human occupation of the steppe caused degradation of the vegetation and the almost complete disappearance of trees. After a period of a harsh dry and cold climate, the region began to know about 12 000 years B.P. climatic conditions comparable to those we know today. It was in this warm context that the Neolithic Revolution was accomplished, in which Man began to settle, to domesticate plants and animals, to specialize in dry farming (wheat, barley, vetches), to raise sheep and goats, and to start the urban revolution at about the 6th millennium B.P. (Sanlaville 1993). This gradual "Neolithization" process slowly spread across the North African coast (as the interior was apparently already too dry), and reached the Aurès Mountains in northeast Algeria at about the 4th millennium B.P. (Roubet 1979). It is highly probable that this spread, starting apparently from western Asia, met with a number of impediments along the northern Sinai coast, at the Delta (where it could cross the Nile only at the latitude of Cairo, at the so-called Cairo biogeographical bridge, cf. Ayyad and Gghabbour 1986), at the northwestern coast of Egypt (Ghabbour and Roubet 1984), and at the Gulf of Syrte (Ayyad and Ghabbour 1993). These strips are now the narrowest corridors of the Mediterranean rainfall regime bordering the whole coastal zone from Palestine to Sfax (Ayyad and Ghabbour 1993). Thanks to the Atlas Mountais, a more typical Mediterranean climate, comparable to that of southern Eyrope, covers the northern parts of Tunisia, Algeria and Morocco, and their climatic conditions were more akin to those of similar European regions during the Ice Ages. Their fauna and flora are also related to the biota of southern Spain (in Morocco), and to Italy (in Tunisia), albeit with a small number of endemic species and subspecies, slightly differentiated from their southern European Palaearctic relatives. The same is true of the fauna and flora of Syria, Lebanon, Palestine, and the high mountains of Sinai, which have some Palaearctic species related to those of Anatolia, Greece, the Caucasus, and Iran (Ayyad and Ghabbour 1986). Most of the species of the arid lands of North Africa, especially south of the Tropic of Cancer, however, belong to the Ethiopian Realm.

As a matter of fact, the meeting line between the Palaearctic and the Ethiopian Realms has never been agreed upon, precisely because of the intermingling between the faunas of the two Realms over the Sahara during the last several million years, as a result of the great climatic oscillations that had occurred, especially in the Pleistocene. Some authors are satisfied by equating the southern limit of the Palaearctic with the 100 mm winter isohyet, thereby limiting it to the narrow Mediterranean strip along the coast. This view disregards the presence of Palaearctic species much further south of that line as a

result of incursions into the Sahara during Pluvial Periods, when temperatures were also appreciably lower (perhaps as much as 5o C, cf. Khalaf El-Duweini and Ghabbour 1968a). Some other authors place the line of demarcation at the middle of the Sahara to take account of those relicts whose ancestors penetrated south from the Mediterranean coast under more favourable climate conditions in the past. Perhaps the more plausible third suggestion is to consider the Sahara as a large Transition Zone between the two Realms, comprising elements of both in various proportions in various places, thereby taking account of the faunistic mixing of species observed in these places, and of the historical events that took place there, that caused this mixing.

The Origins of The Fauna of North Africa

The animal species that are known as indigenous to the arid lands of North Africa came to them from different directions. Entry of fauna species into North Africa is intimately related to the geological history of the region since the beginning of the Miocene. Within the Ethiopian Realm in tropical Africa, two main faunas can be distinguished, the forest fauna and the savanna or steppe fauna, which is more recent. During the Miocene period (from 25 until 12-15 million years ago), most of Africa was covered by forest that extended through Arabia into India and South East Asia, so that a more or less uniform flora and fauna spread over the whole area. This accounts for similarities between the Ethiopian and Oriental faunas.

The moist period of the Miocene and part of the Pliocene was followed by a dry one, when much of the rain forest disappeared, so that the African forest fauna was isolated from that of Asia. Some of the original inhabitants of the rain forest succeeded in invading the growing savanna and in adapting to life in it. The dry period of the Pliocene did not last long, and in the following pluvial periods the trend was reversed. Repeated climatic changes have affected not only the distribution of mammals, but of other vertebrates and invertebrates. Communication between the great drainage basins during pluvial periods explains why many fish and mollusk species are common to those basins in Africa.

The Pliocene epoch (12-15 million years to about 2 million years ago), saw the uplift of the Ethiopian Highlands and Mounts Kilimanjaro and Kenya, while the Cameroon Mountains may be from the Pleistocene. These geological changes had nevertheless a slight effect on the climate of Africa compared with the great fluctuations that occurred in the world climate, which lasted from the end of the Pliocene until about 11 000 years ago. They are especially significant in our understanding of the distribution of animals within Africa today. The Pleistocene is characterized by waves of extreme cold and hot periods that came and went over Europe and North America, the Glacial Ages. Many animals could escape the advancing ice and migrated towards Africa. These Glaciations could not happen unless there was a general increase in humidity and a lowering of mean annual temperatures, so that the ice could be formed and remain. The climate of Africa was drastically changed and we find here 3 or 4 or perhaps 7 periods of increased rainfall alternating with periods of drought. It is not yet established whether these pluvial periods were contemporaneous with the Glacials of Europe, or alternated with them, or had quite a different rhythm. It is well established however that the Mediterranean coast of Africa enjoyed a climate similar to that of southern Europe today. Higher rainfall, together with higher humidity and lower temperature, attracted the European animals escaping or spreading from Europe. During the Pluvials too, the Sahara was a vast grassland that allowed almost free advance of central African animals till the Mediterranean coast, and also the southward penetration of European animals to as far as the Hoggar Mountains, Bilma, and Kufra Oases. this is why the Sahara is not a zoological realm by itself, but a meeting place of European and African species, in different proportions. It is therefore a large transitional zone. Many European species were found in the oases of the Sahara, and are relicts of the Pluvial periods, cut off after the Sahara dried up and precluded the movement of animals unable to fly and needing water for the continuation of their life cycles. It is very doubtful that such relicts still exist after modern developments in the last decades.

During the last major Pluvial period, which continued for at least 70 000 years, and up to perhaps

as late as 70 000 years ago, the African Continent must have been 4-6 degrees C cooler than today. There was a post-Glacial optimum 7 000 to 5 000 years ago which was probably slightly warmer than the present time. This optimum was the period of the Neolithic revolution of human cultures. Although its extent was much less than last Pluvial, which favoured animal migrations, it was very effective in changing animal communities, particularly the large mammals, by the action of Man. During the last Glacial-cum-Pluvial period, it is known that the Sudanese climatic belts moved some 500 km northwards so that the northern limit of Lake Chad was at 19 o N lat. But the climate of the Sahara became much more arid during the past 10 000 years or so. It has long been thought that many African mammals were descendants from Palaearctic stock, but it is now known that they are essentially African in character from the earliest Pleistocene. [This part is largely based on Cloudsley-Thompson (1969).]

As far as Egypt is concerned, the origin of her land fauna as presented by Ayyad and Ghabbour (1986) and Ghabbour (1992) is from: (1) the Sinai Peninsula from Asia, (2) the Red Sea Mountains from Ethiopia, (3) the Nile stream through the Nubia Nile and the bordering flood plains from the Sudan Gezira, (4) the Darfur Highlands from Sudan and from the Ennedi-Tibesti Highlands, and (5) the Mediterranean coast and the Gaghboub (or Giaraboub) route into Siwa for animals coming from Libya. These routes of entry of fauna are comparable to those of the arid lands of North Africa as a whole. The latter are mainly through Sinaï and from southern Europe, for Palaearctic species (and for some Oriental species as well), and from the Sahelian region, from the Nile, or from the Red Sea Mountains for Ethiopian species. It is noteworthy that the latter route served for a penetration of Ethiopian animals and plants into western Asia through the Araba (or Arava) Valley extension of the African Rift Valley into Palestine and Jordan.

The Importance of Soil Fauna in Biodiversity Studies

The soil system is inhabited by such a great variety and diversity and concentration of soil animals that collaborate in the elaboration, maintenance and evolution of its structure and its characteristics that if zoosociology is to advance as a sub-discipline of animal ecology, soil animals would very pertinently lend themselves to this kind of study. This is because they are more sedentary and hence more likely to be collected as a comprehensive fauna, and are also more likely to reflect environmental conditions not only within the soil but also above it. Because the soil is a secluded environment, some elements of the soil fauna may remain in that medium even after the environmental conditions that favoured their life in it have gone, hence the description of the soil as a "conservative" environment. Soil fauna species are also more numerous and more diverse than above ground faunas, and thus offer a much wider range of taxa with high variability and so more amenable to classification. Their variability goes hand in hand with changes in environmental conditions, comprising variations both in time and space (Ghabbour 1991 a). The importance of soil animals in biodiversity studies was also stressed by Lee (1991) and Lal (1991). During land reclamation for agricultural development in deserts, such as the Mariut region west of Alexandria, drastic changes occur in the diversity of populations of soil fauna, as the soil environment is transformed from a desert one to an agro-ecosystem one. Monitoring of these changes and the environmental conditions that will favour the appearance of pest species, and may also cause the disappearance of some useful detritivores helpful in the maintenance of biological soil fertility, becomes a very important aspect to be closely watched (Ghabbour et al. 1985, and Ghabbour 1986). Furthermore, study of the diversity of soil fauna populations can be used as a tool for the choice of nature and biospere reserves (Ghabbour 1988 a), and for the characterization of sites on the basis of environmental criteria (El-Shishini and Ghabbour 1988).

Studies on the Diversity of Soil Fauna in North Africa

An important review of the diversity of soil animals, together with other animals, can be found in Niethammer (1971). An important aspect to be considered in arid lands zoology, is that in the arid lands of North Africa, soil animals exhibit a large array of adaptations to heat and drought. Their

adaptations are of three types: morphological, physiological, and behavioural. In most species, adaptations are mainly at the level of the individual, but social adaptations are also present in species like ants and termites, which regulate the environment of the nest so as it is made suitable for the life of the whole colony. One species with a remarkable set of adaptations is the sand roach Heterogamia syriaca Sauss. (Blattidae, Dictyoptera, Insecta). It has a body shape and fossorial legs adapted for digging and hiding in the sand. It can absorb water vapour from ambient air at a relative humidity down to 87%, and can resist loss of water vapour from its body surface at very low relative humidities and at high temperatures (Ghabbour et al. 1991). These adaptations tempted one pharmaceutical company in Europe to use it as a source for drugs.

The extensive studies and sampling of soil fauna in the Sudan and northern Ethiopia (now Eritrea) by Prof. J. L. Cloudsley-Thompson (now at London University), when at the University of Khartoum, in the 1960's, produced such a wealth of data on soil fauna populations and their diversity, that they were a good basis for analysis by modern statistical methods (such as correspondence analysis and ascending hierarchic classification). They were effectively used for such analyses by Mikhail (1987), El-Shishini and Ghabbour (1989), Al Ayoubi et al. (1991), Qannari and Beninel (1994), and lately by Kheirallah and Mikhail (in press), who compared African data with those from Yemen and Kuweit. Similarly, the extensive studies and sampling of soil fauna in the Libyan coast by Prof. Shakir Hammad (1974 and 1979) (now at the University of Alexandria), when at the University of Tripoli, in the 1960's also, were amenable to such analyses that were effectively carried out by Ghabbour (1984) and by El-Shishini and Ghabbour (1986). In the latter study, data from southern Tunisia collected by the IBP-Tunisian Pre-Saharan Project were also added. [For a detailed account of studies on soil fauna in the deserts of Egypt and neighbouring countries, see Ghabbour (1988 b).] Moreover, Ghabbour et al. (in press) have studied the diversity of soil fauna in natural and man-regulated habitats in southern Egypt, in Kenya, and in northern Tanzania, and found much interesting results about diversity indices of the total fauna as well as for the functional groups: detritivores, herbivores, and carnivores, as we go from north to south.

The Example of Oligochaeta

But probably the best way to follow the routes of entry of soil animals, and to explain their diversity in the arid lands of North Africa, is to take the example of Oligochaeta. They are the earthworms and their aquaticc allies, a Class of Phylum Annelida. Oligochaeta are a suitable group for this kind of study because they cannot cross dry land. They die if they remain in the air for more than some minutes (Ghabbour 1975). Their egg cases also do not withstand dry air for more than a few hours. The presence of aquatic oligochaetes, which are even more sensitive to dryness than their terrestrial relatives, in the oases of the Sahara, cannot be attributed to transportation by Man except in very few cases. Transportation by migratory birds is also very much unlikely, not only because they cannot withstand drought when transported over long distances, but also because their distribution in these oases does not follow migration routes of birds, or proximity to points of origin of these routes. The presence of an endemic oligochaete speies in the Tarhuna Oasis near Tripoli, con-generic with another specis in Siwa Oasis in north western Egypt, and with a third species in Selima oasis in northern Sudan, cannot possibly be due to either human or to bird transportation. Likewise, the presence of another endemic species in Kharga Oasis in southern Egypt and in the western Nile Delta, with relatives in southern Sudan, cannot be also the result of fortuitous transportation. More evidently, the presence of a third endemic species in Dahshur Lake near Giza, in the vicinity of Cairo, con-generic with other species found only in West Africa, cannot be by chance (Table I). Therefore the Oligochaeta can confidently be selected as a key to the biodiversity of soil animals in the arid lands of North Africa.

The biodiversity of oligochaetes in Egypt and in north east Africa was studied by Khalaf El-Duweini and Ghabbour (see for example Khalaf El-Duweini and Ghabbour 1963, 1967, 1968 a and b). Like other animal groups in these arid lands, Oligochaeta species of North Africa belong to both the

Palaearctic and the Ethiopian Realms (Fig. 1). Species from the Palaearctic Realm came from three routes: the Gibraltar Straits, the Ligurian Islands (and Sicily), from western Europe, and across the Sinai Peninsula, from the Balkans. These are mostly terrestrial species. Those species of the Ethiopian Realm came only through the Nile from two sources: East Africa and West Africa. These are mostly aquatic species. Different regions of the Sahara contain different species of Oligochaeta, indicating that each of these regions had a different geological history and a different provenance of its oligochaete speies (El-Kifl and Ghabbour 1984). According to Omodeo (1954), the Western Sahara contains only two species: the ubiquitous Allolobophora caliginosa and the aquatic Eiseniella terraedra. Morocco and Algeria have in addition Eisenia rosea, which extends to Egypt and the Levant, and Octolasion complanatum found in Tunisia but not in Libya or Egypt. Another pair of species: Eisenia foetida and Octolasion lacteum, are found in Morocco and northwest Algeria. All six of these species occur in the Canary Islands and belong to the Palaearctic Family Lumbricidae. This distribution indicates migration from the Iberian Peninsula towards the Western Sahara in one direction and towards Algeria in another direction. About Allolobophora caliginosa it must be said that it occurs in almost all oases of the Sahara, including Monastery gardens near the Red Sea coast in the Eastern Desert of Egypt. This species is therefore of really no zoogeographic significance, as it is easily transported by agricultural extension and plant introductions. An Egyptian population of this species was found to have three regions of temperature preferences along a temperature gradient, indicating its multiple origins (Khalaf El-Duweini and Ghabbour 1965).

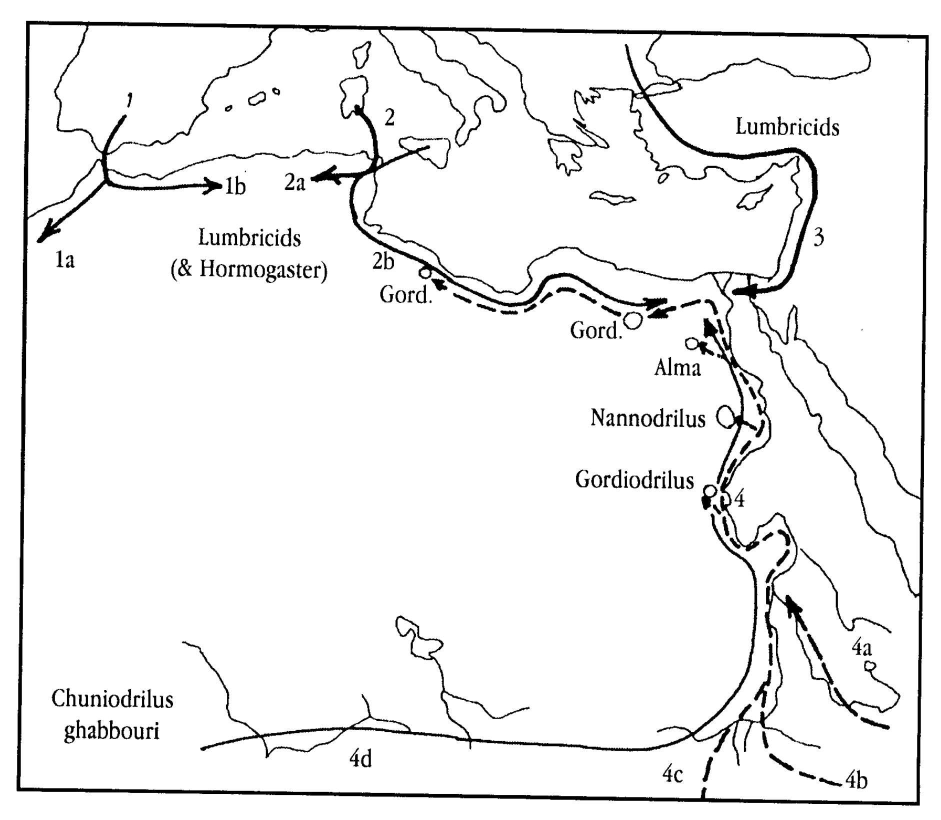


Fig. 1- Probable routes of entry of Oligochaeta (earthworms and their allies) into the arid lands of North Africa 1= Gibraltar Straits, la= to the Western Sahara and the Canary Islands, 1b= to eastern Morocco and western Algeria, 2= Sardinia/Sicily/Tunisia, 2a to eastern Algeria, 2b= to Libya and Egypt, 3= the Balkan/Anatolia/the Levant, 4= the Nile, 4a= the Blue Nile, 4b= Kenya, 4c= the Lakes Plateau, 4d= West Africa.

Another migration occurred from the central Mediterranean as is attested by the presence of Helodrilus festai in northern Tunisis as well as in Sardinia, Sicily, and Calabria. Another species, Hormogaster redii (Fam. Hormogastridae), occurs in northern Tunisia and northeast Algeria. The Family originated in the region of the East-Pyrénées/Sardinia/Corsica and the Maures during the Palaeocene (Bouché 1983). Before the Oligocene, Corsica and Sardinia broke away from Catalonia and southern France, while at the end of the Miocene the Mesogea, the present day Mediterranean, fell to a low level, so that H. redii could spread around (Bouché 1983). Eophila moebii and Dendrobaena byblica, occur in Portugal, and not in Morocco (at least not found), but occur in northern Algeria.

The lunbricid species Eisenia rosea is of several forms. It occurs in the eastern Nile Delta in the typical form, but in Siwa Oasis as a form resembling the one occurring in Sardinia, suggesting that the species may have come to the Oasis along the Mediterranean coast from Sicily and Sardinia, as it occurs also in Tripolitania. Moreover, Eiseniella tetraedra was recently found at Burg El-Arab, on the Mediterranean coast, 53 km west of Alexandria (El-Kifl and Ghabbour 1984). This western Palaearctic migration route may also include Octolasion cyaneum, recorded in north west Africa, without precise locality.

Six genera of Lumbricidae with several species occur in Lebanon and Palestine, yet only two species managed to cross the Sinai Desert and the desert west of the Suez Canal region (the Isthmic Desert), and settle in the African soil. These are Allolobophora jassyensis var. orientalis (first found in Jassy, Romania), and Eisenia rosea (a form different from that of Sardinia and Siwa Oasis). Both species are confined to the eastern Delta. Thus all European oligochaete species that managed to penetrate into the Sahara remain confined to its northern rim, except Allolobophora caliginosa (which is of no zoogeographical significance, as explained earlier). Moreover, west European oligochaetes, which could cross the desert of the Gulf of Syrte of Libya and the Marmarica coastal desert between Cyrenaica and Alexandria, remain at the western part of the Nile Delta, while east European species, which could cross the Isthmic Desert, remain at the eastern part of the Nile Delta. The Delta was thus a barrier to a possible exchange, or overlap, between the two faunules. This may be because the Delta was submerged during the last phases of the Pleistocene, as is thought, and was subjected to cultivation and drainage in historical times (Khalaf El-Duweini and Ghabbour 1968 a).

Ethiopian species came along four routes of migration. The first is of minor importance. It concerns the route of the Blue Nile. Probably because of its strong torrential currents, Blue Nile species, although quite numerous, stopped at its end, just before Khartoum (Ghabbour 1976). At any rate, the Blue Nile is known to be of recent geological origin. Its torrential nature may be the cause for the absence of oligochaetes from its steep banks. The second route is from Kenya. It is only one species known to have survived which should have originated from these and reached as far as Siwa Oasis. This is the aquatic Allonais paraguayensis. The third route is from the Lakes Plateau and its species reached Selima Oasis in northern Sudan, and in Kharga, Bahariya and Siwa Oases in the Western Desert of Egypt, and as far as Tripolitania. This group is represented by 3 species belonging to the genus Gordiodritus. These are G. zanzibaricus in Selima Oasis found also in East Africa, the endemic G. siwaensis in Siwa Oasis, and the endemic G. pampaninii in Tarhuna, near Tripoli. The group is also represented by the endemic Nannodrilus staudei in Kharga Oasis and the western Nile Delta, and by 2 species of the genus Alma. These are A. nilotica in the Nile and in Bahariya Oasis, and A. stuhlmanni in the canals near Cairo. The genus Alma is represented in Africa by 12 species, but A. nilotica occurs only in Egypt and in the Sudan as far as the latitude of Khartoum. Other species of Alma occur only further south in the Sudd region in southern Sudan (Jamieson and Ghabbour 1969). The fourrth route is from West Africa, and is represented by the endemic Chuniodrilus ghabbouri (Jamieson 1969), which occurs at Dahshur Lake near Giza, in the vicinity of Cairo.

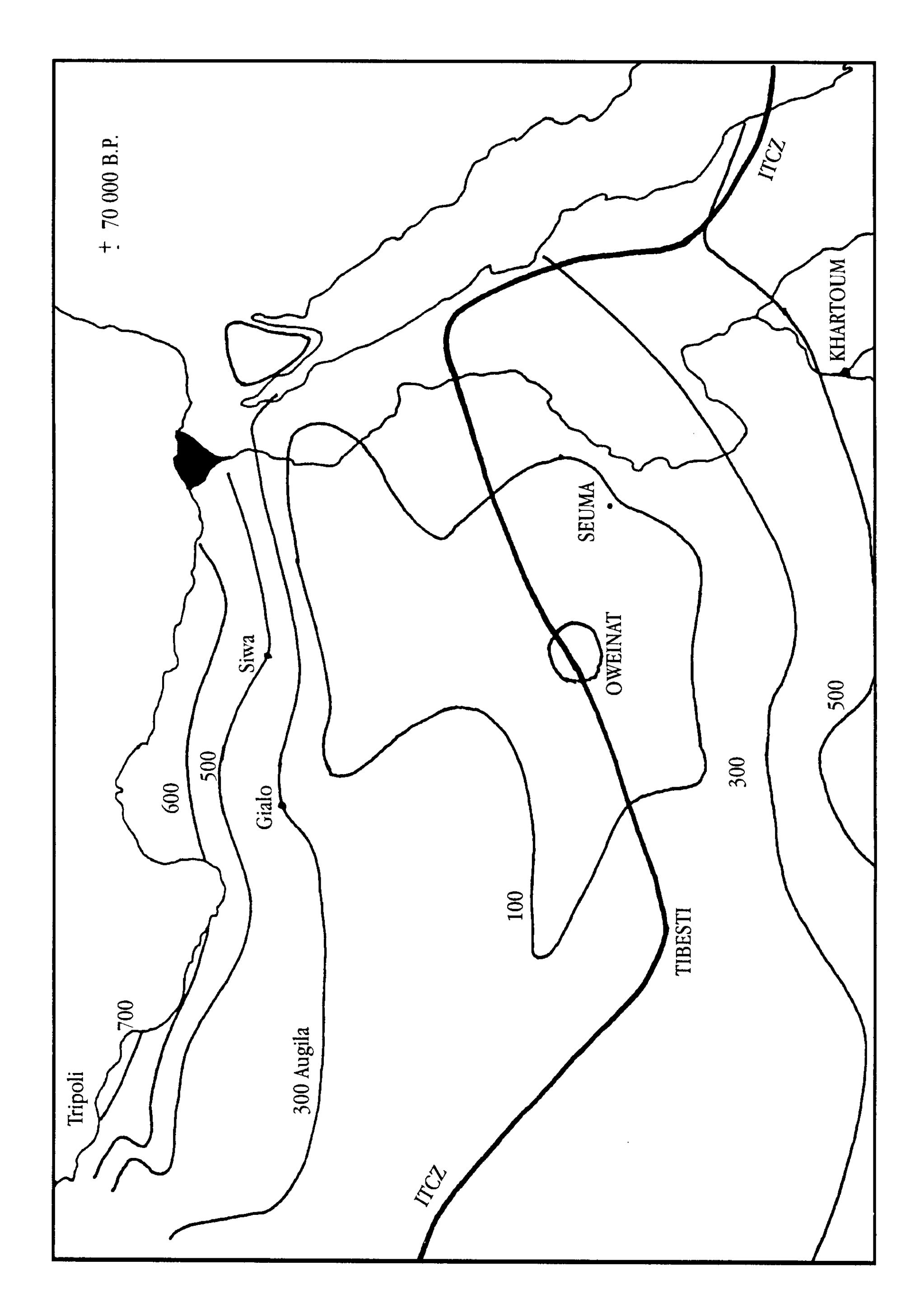


Fig. 2- Probable rainfall isohyets during the last major Pluvial (140 000 - 70 000 years ago), in north east Africa, based on the distributin of Oligochaeta. ITCZ= Inter-Tropical Convergence Zone (after Ghabbour 1991 b). This rainfall accounts, with its long duration and high intesity, for the huge underground fossil water reserves in the deserts of Egypt, Libya, Chad, and the Sudan. During that period, the Nile Delta was submerged.

The remarkable high rate of endemicity in aquatic African oligochaetes in northeast Africa, as contrasted to the low rate of endemism among European species of North Africa, observed only at the level of forms, should indicate a much older entry of Ethiopian species, and also a much more stable environment, but also an old isolation of the Oases. At any rate, Egypt and Libya at present share oligochaete species from the Palaearctic and the Ethiopian Realms, thanks to a more favourable rainfall regime along the Mediterranean rim on one hand and the flow of the Nile on the other hand. In order to define the period in which oligochaetes of the arid lands of North Africa could migrate across the now barren deserts, the figure of 500 mm/year rainfall found by Pickford (1937) to be the limit of endemic earthworms in South Africa was taken as an arbitrary measure. As a matter of fact, no earthworms occur in winter in the soil in the area of Nyala in western Sudan, with a 500 mm summer rainfall, so that the effective rainfall is somewhat lower than in the Mediterranean. However, earthworms remain in water pools left over after the summer rainfall, a few kilometers south of that city (Ayyad and Ghabbour 1986). Accordingly, the probable rainfall isohyets during the Upper Pleistocene, which allowed migration of oligochaetes in the eastern Sahara, were calculated on the basis of the minimun soil moisture requirements of earthworms and the 5o C decrease in overall mean annual temperatures, by Ghabbour (1991 b) and are shown here in Fig. (2). These isohyets were found to be consistent with the calculations of Butzer (1958 and 1964) for probable rainfall in the region of north east Africa, based on geomorphology and stratigraphy. Rainfall that would favour earthworm migrations along the Mediterranean coast from the Nile to Tripolitania could not therefore have occurred during the Neolithic Period, but rather during the last major Pluvial of more than 70 000 years ago, viz., in the Upper Pleistocene. The coastal desert strip between the Nile Delta nd Cyrenaica was a hiatus for most of the Holocene (Ghabbour and Roubet 1984). A recent map of fossil large mammals in the Sahara of the Neolithic Period (Fig. 3), shows that they do not go further north than the Tropic of Cancer (Allard-Huard 1994), so that Neolithic rainfall was most probably not suitable for movement of Oligochaeta across the Sahara. The role of the Nile stretches in the region of Nubia between the northern Sudan and southern Egypt, namely between Khartoum and Aswan, at present, and probably also in the past, needs elucidation. This part of the Nile apparently did not allow a free passage for all species, whether animal or plant. At present, the Nubia Nile in both the Sudan and Egypt contains only two thirds of the weed flora of the large Gezira plains in central Sudan and the similar weed flora of the cultivated fields in Egypt (Ghabbour 1987). The Nile Nubia, because of the narrowness of its banks, reaching a maximum of 4 kms in some places, acted as a filter rather than as a bridge between the Upper Nile and the Egyptian Nile, allowing only a limited number of species to take advantage of it for migration along the Nile.

There is still a group of 4 species found in Egypt and belonging to the genus Pheretima of south-east Asian origin (Oriental Realm). This group was most probably introduced from that region through the importation of plants and trees apparently starting from the early and middle 19th century onwards (Khalaf El-Duweini and Ghabbour 1963 and 1968 a). Only one species of this group, Pheretima elongata, occurs in the Sudan. It can be found from the arid Dongola in the north to the humid Malakal in the south, and as far west as Gebel Marra (Ghabbour 1976). The Chad-Nile watershed at Gebel Marra harbours many oligochaete species which need to be investigated. The occurrences of Pheretima, again, do not have a zoogeographical significance.

More studies are needed for the elucidation of the relationships between Oligochaetes of Egypt and those of Central Africa. Let us recall that of the more than 60 moss species occurring in Egypt, only one species is from Central Africa, Philonotis sp., and the rest are Mediterranean (Imam and Ghabbour 1972). Strange enough, this Central African moss is the only one that harbours oligochaetes within its thallus. It occurs, with the oligochaetes it harbours, only in Fayoum and in the western Nile Delta. The oligochaete species occurring with this moss has not yet been identified. This is a strong plea to encourage faunistic investigations of oligohaetes in North African and West Asian countries, where such studies are either insufficient or are completely lacking.

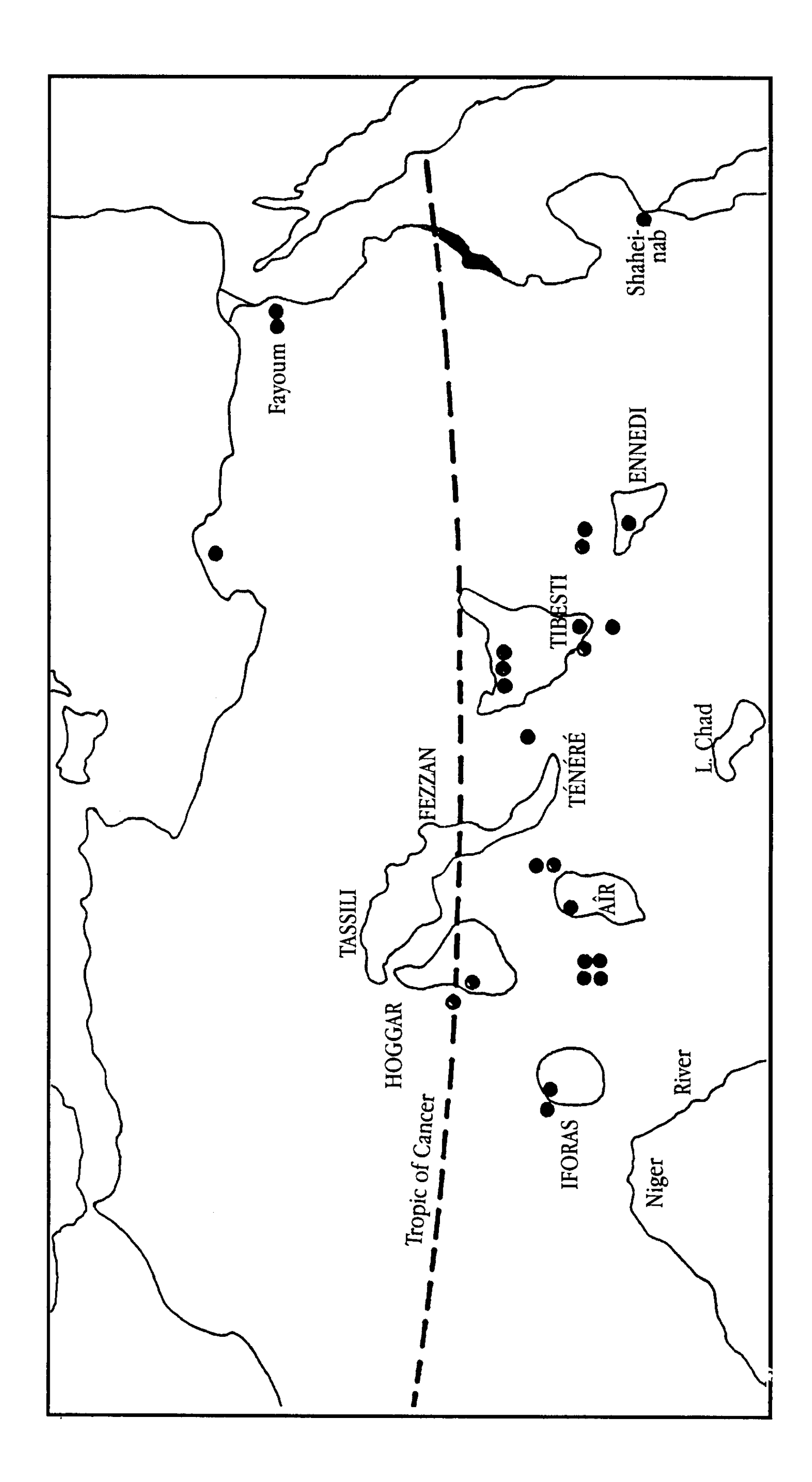


Fig. 3- Fossil remains of Neolithic large mammals in North Africa (after Allard-Huard 1994). Note that they do not go northwards beyond the Tropic of Cancer, except in Fayoum and Cyrenaica, aided by the Nile.

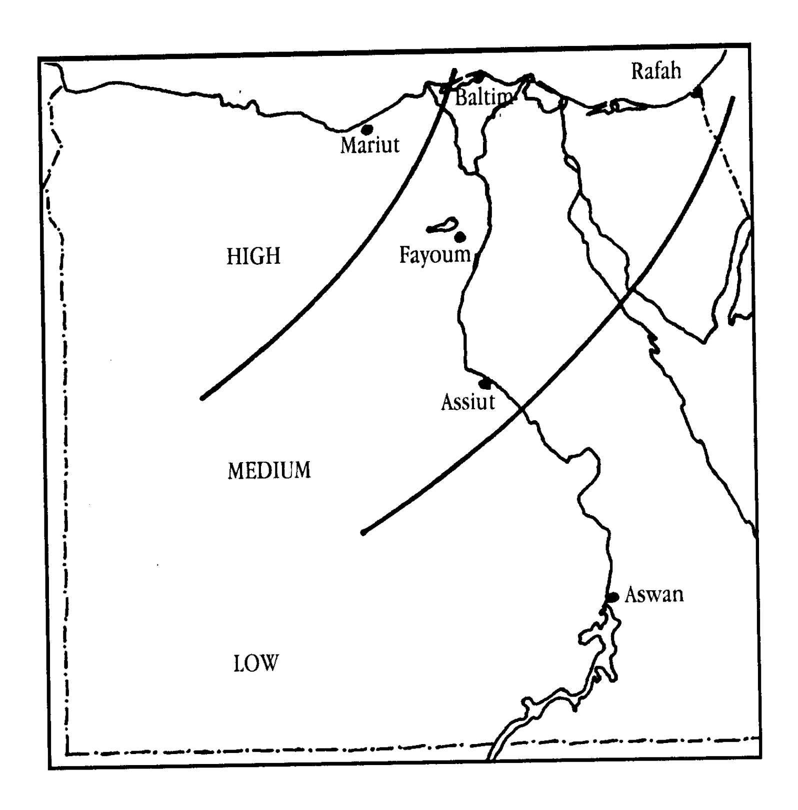


Fig. 4- Zones of decreasing diversity of soil animals from north to south in Egypt (after Ghabbour and Mikhaïl 1993a and 1993b).

Soil Fauna, Do They Need Conservation?

The story of other groups of soil fauna is a more or less similar replica of the story of oligochaetes. Ghabbour and Mikhail (1993 a and b) studied the diversity of soil fauna in Egypt in a number of sites ranging from the Mediterranean coast to the vicinity of Lake Nasser (the Aswan High Dam Lake) in the south. They found that the Simpson and Shannon diversity indices decrease from north to south (Fig. 4), in accordance with the increase of mean annual temperatures and the decrease of relative humidity. This decrease in gardient more or less coincides with a gardient of C3/C4 graminaceous plants in Egypt, associated with the same environmental conditions (Batanouny et al. 1988). But what is more important is that the proportions of the three main functional groups of soil fauna: the detritivores, the herbivores (potential pests), and the carnivores, and their diversity indices, also change following the same trend (Ghabbour and Mikhail 1994). In this latter work, the concept of ecosystem maturity has been tested and found to correspond to the intensity of human interventions. Human impact is an effective factor in the variability of the diversity of soil animals in arid lands, as well as in the maturity or contra-maturity of ecosystems. Studies of soil fauna biodiversity can therefore be a good indicator of ecosystem maturity, and hence of the degree of human manipulation. Newly reclaimed desert lands have a high proportion of herbivores, and are followed in time by detritivores and then carnivores. At any rate, they have a much lower diversity than grazing land ecosystems, which in turn have a lower diversity than the least disturbed ecosystems. This is one more reason for the conservation of natural areas in each North African country to make use of the diversity of detritivores and carnivores they con-

tain. This is the cryptic fauna that is seldom looked at when considering conservation plans, but which is probably as important, though less aesthetically attractive, than birds and mammals, or even butterfiles that are in fact the adult stages of herbivores, i.e., potential pests. No farmer would support the idea of coservation of biodiversity if it includes herbivores (potential agricultural pests), but will certainly be more responsive to the idea of conserving carnivores (potential natural enemies of agricultural pests), and probably to a lesser extent the conservation of detritivores, for maintaining soil fertility. The first Egyptian laws on bird conservation, issued in 1918, let us remember, were for the conservation of entomophagous bird species, to help farmers in their fight against notorious cotton pests. It can be seen that conservation of biodiversity, though the term was not yet known, was already regarded at the time of prime economic importance.

Recommendations

A recent publication on the conservation of African biodiversity (Cole 1994) gave some recommendations for its conservation, relying on the mandate of the African Ministerial Conferrence of the Environment (AMCEN). Since the North African region is also within the mandate of AMCEN, these recommendations apply very pertinently. However, we may reformulate them as such:

1. There is need to improve knowledge about the biodiversity of soil animals in the arid lands of North Africa. We still do not have data about large areas in these lands , even in countries where some rather satisfactory knowledge is available such as Tunisia, Libya, Egypt, and the Sudan. There is also almost nothing known about the soil faunas of the Arabian Peninsula, which is a natural extension of these arid lands (Sanlaville 1993).
2. There is need to maximize the value of soil fauna as agents in soil fertility, natural enemies of pests, among other things, and probably as sources of medicine as well.
3. There is need to spread the message about their value to as wide and as diverse a public as possible.
4. There is need for more trained personnel, especially in taxonomy and ecology. There could possibly be no ecology without good taxonomy.
5. There is need for better laws and regulations and for better enforcement of existing ones.
6. There is need to revise existing international conventions such as the OAU Convention of Algiers 1968 on the Conservation of African Natural Resources.
7. There is need for a suitable and a working database on the biodiversity of soil animals in the arid lands of North Africa and their sustainable utilization.
8. There should be encouraged a rational utilization of soil animal resources in the arid lands of North Africa, but under strict control.
9. Together with rational utization, there should be efficient protection of these resources.
10. Finally, there should be a networking of scientists and research institutions of the arid lands of North Africa to enhance cooperation, exchange of information, training, and collaborative research projects amongst them, perhaps on the lines of the UNESCO-MAB Biosphere networks, but complementary to and not overlapping with them.

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TABLE I- Origin and present distribution of oligochaetes (earthworms and their aquatic allies) in the arid lands of North Africa, after Khalaf El-Duweini and Ghabbour (1968 a) and El-Kifl and Ghabbour (1984).

Species	Origin	Present Distribution
Eiseniella tetraedra	Iberian Peninsula	Morocco,
Eisenia rosea		Algeria
Eisenia foetida		Canary Islands
Octolasion complanatum		
Octolasion lacteum		W. Algeria
Allolobophora caliginosa	various	all Saharan
		Oases
Eophila moebii	Portugal	northern
Dendrobaena byblica		Algeria
		northern
		Tunisia
Helodrilus festae	Sicily, Sardinia	northern
Hormogaster redii		Algeria
Eiseniella teraedra		NW Egypt
Eisenia rosea		Siwa Oasis
Octolasion cyaneum	... (?)	NW Algeria
Allolobophora jassyensis var.	the Balkans,	E. Delta
orientalis	Anatolia,	E. Delta
Eisenta rosea	the Levant	

Various species (see Ghabbour 1976)	Ethiopia	Blue Nile
Allonais paraguayensis	Kenya	Siwa Oasis
Gordiodrilus zanzibaricus	Lakes Plateau,	Selima Oasis
G. siwaensis		Siwa Oasis
G. pampaninii		Tarhuna Oasis
Nannodrilus staudei		Kharga Oasis and W. Delta
Alma nilotica	Lakes Plateau, Central Africa	Nile N. of Khartoum, Bahariya Oasis
A. stuhlmanni		Cairo region
Chuniodrilus ghabbouri	West Africa	Dahshur Lake, (near Cairo)
Pheretima spp.	S. E. Asia	Egypt and Sudan
Various species (under study)	Chad/Nile watershed	Gebel Marra (W. Sudan)

Remarks
1) The occurrences of Allolobophora caliginosa and Pheretima spp. are of no zoogeographical significance, as they are easily transported by human activities.
2) One theory has it that the ancestors of the genus Alma originated in Europe in the Tertiary as a branch of Fam. Criodrilidae, and later entered into Africa through the Nile, where they diverged into several species in different parts of Africa south of the Sahara.

The Establishment of a National Plant Genetic Resources Laboratory in Egypt

The Right Approaches for the Achievement of the Goals

By

A. ABOU ZEID

National Co-ordinator for Plant Genetic Resources

Agricultural Research Center, Ministry of Agriculture and Land Reclamation, Egypt

Introduction

Plant genetic resources are the raw material required by plant breeders and biotechnologists for the development of new, superior crop varieties which can ensure a stable, plentiful supply of high quality food, feed and fiber. Maintaining the local genetic diversity of crops as well as conserving wild plants in a genebank has therefore become a top priority in agricultural policy.

The loss of native plant genetic resources as well as the earlier introduced, but well adapted, cultivars in Egypt is a serious concern today. These rich sources my contain genes for disease and insect resistance and other desirable traits which might be needed in national and international crop improvement programmes.

In Egypt, there is an urgent need to establish a National Plant Genetic Resources Laboratory in order to stop the systematic loss of valuable genetic material as well as to improve all activities related to a proper and well functioning germplasm network in the country. Extending services to other countries in the region as well as coordinating activities one urgently required.

Objectives

The main objectives of the establishment of a National Plant Genetic Resources Laboratory are:

1. Organization of germplasm exploration and collection missions.
2. Retrieval of Egyptian germplasm which has been collected in Egypt in the past and stored in other genebanks in the world as well as the introduction of other valuable genetic resources from abroad.
3. Conservation of the germplasm under optimum conditions.
4. Evaluation of the germplasm for highly heritable characters.
5. Rejuvenation and multiplication of the genetic material according to need.
6. Proper documentation of germplasm information.
7. Undertaking research work to overcome constraints that arise during the work.
8. Extending activities and services to other countries in the region.
9. Exchanging of germplasm and its information and coordinate activities with other national and international institutions.

III. Co-ordination of Activities

The National Plant Germplasm System should be a network of organizations and people dedicated to preserving the genetic diversity of crop plant germplasm from all over the world, including Egypt. Curators and other scientists have to preserve, evaluate and catalog this germplasm and distribute it to people with valid use.

We need a national system to avoid unnecessary duplication and to co-ordinate funding and information.

IV. Work Organization

The "National Plant Resources Laboratory" (Gene Bank) will be responsible for the long-term germplasm preservation (base collection) and its computerized data. The Gene Bank will take care of the coordination of national activities and distribution of preserved germ plasm to users.

The Gene Bank should be integrated with the commodity agricultural breeding and research institutions under the same mother organization, in our case the "The Agricultural Research Center". The central Gene Bank in Giza should have several units integrated under the already existing agricultural research stations distributed all over the country. This will give the Gene Bank the opportunity to multiply and evaluate the germ plasm under its favoured environmental conditions as well as to maintain the living collections at the right site.

A plant Genetic Resources and a Crop Advisory Committee will be established. The two committees should give, as supporting bodies, technical advice to the Gene Bank and help in solving problems that might arise:

The Gene Bank will consist of the following 4 major working units:

- Exploration and collection
- Germ Plasm Preservation
- Multiplication, Evaluation and Exchange
- Documentation

PLAN OF OPERATION FOR THE NATIONAL PLANT GENETIC RESOURCES LAB./EGYPT

OUTPUTS/ACTIVITIES		OUTPUTS/ACTIVITIES	
1-	**Adequate personnel available**	**2-**	**.Adequate program/strategy for Germplasm network developed**
1.1	Assign genebank director x (allready assigned)	**2.1**	Identify institution for genebank formation (naticnal and international)
1.2	Identify manpower/personnel required	**2.2**	Establish contact with identified institutions
1.3	Formulate job description for personnel	**2.3**	Form National Germplasm committee
1.4	Assign head for each genebank unit	**2.4**	Organize meeting
1.5	Identify training requirements	**2.5**	Form crop advisory committee
1.6	Develop training curriculum	**2.6**	Organize meeting
1.7	Secure adequate training funds	**2.7**	Define responsibility and functions of coop. institution
1.8	Identify candidates for training		
1.9	Identify institutions for training	**3-**	**Genebank building constructed furnished and equipped**
1.10	Follow up the implementation of training	**3.1**	Identify suitable genebank site
1.11	Assign rest of genebank staff	**3.2**	Prepare construction plans
1.12	Participation in national and international workshops & conferences	**3.3**	Prepare tender documents
		3.4	Secure adequate funds for construction
		3.5	Call for tender
		3.6	Follow up the construction
		3.7	Overtake the new building
		3.8	Follow up the furnishing of building

PLAN OF OPERATION (CONT.)

OUTPUTS/ACTIVITIES	OUTPUTS/ACTIVITIES
3.9 Identify needed equipment and working facilities	4.7 Secure funds for exploration and collection missions
3.10 Secure funds for equipment and working facilities	4.8 Carry out exploration and collection work
3.11 Order the equipment and working facilities	4.9 Establish herbarium specimens
3.12 Follow up the delivery, installation and operation test of working facilities	
	5- Plans for germplasm processing, testing and conservation finalized and its implementation initiated
4- Adequate program/strategy for germplasm collection developed and activities started	5.1 Prepare working manuals for the unit
4.1 Finalize inventory on previous exploration and collection	5.2 Determine size and type of working and storage facilities
4.2 Identify areas with high genetic erosion	5.3 Secure operational funds
4.3 Establish crop priority list for collection	5.4 Initiate activities for the introduction of tissue culture and cryogenic methods for long-term conservation
4.4 Finalize plans for exploration and collection	5.5 Adapt internationally developed techniques and methods under local conditions
4.5 Prepare working manuals for genebank collection unit	5.6 Finalize plans for germplasm conservation in the field
4.6 Make equipment and facilities for the missions available	5.7 Identify required working facilities for the mini genebanks at local stations

PLAN OF OPERATION (CONT.)

OUTPUTS/ACTIVITIES		OUTPUTS/ACTIVITIES	
5.8	Develop plans for the storage of safety duplication of base collection	**7-**	**Documentation system established and routine work started**
5.9	Initiate routine activities of the genebank unit	7.1	Planning and procurement of hard - and software
5.10	Conduct research work according to plan	7.2	Produce required data sheets and forms for various activities.
6-	**Plans for field activities and routine work initiated**	7.3	Distribute data sheets and forms to all users
6.1	Identify adequate field plots all over the country	7.4	Organize data retrieval of germplasm from research stations
6.2	Design plots lay out	7.5	Establish the necessary data bases
6.3	Prepare plan for construction of greenhouse	7.6	Produce requested printout for lists, catalogues, etc.
6.4	Classify germplasm to be multiplied, rejuvenated, characterized and evaluated	7.7	Prepare working manuals for the unit
6.5	Distribute the developed descriptor list and data sheets	7.8	Ensure adequate system analysis
6.6	Prepare working manuals for the unit	6.9	Secure operational funds
6.7	Secure operational funds for field activities	7.10	Identify adequate literature for library
6.8	Multiply, rejuvenate, characterize and evaluate germplasm	7.11	Establish library
6.9	Conduct further germplasm evaluation	7.12	Establish a proper conference room
6.10	Conduct research work according to plan		

BUILDING AND WORKING FACILITIES FOR THE PGRU/E

Buildings	Area (sq.m)	Equipment For:
Main Building	3110	Exploration & collection Laboratory Seed Conservation Lab. i) Cold Stores ii) Seed Drying Unit iii) Containers for Cryogenic Preservation In-Vitro Preservation & Research Unit Germplasm Evaluation Laboratory Data Management Unit Common Facilities (Herbarium Room, photogr. Room, Centrifuge Room, Growth Chamber Room). Conference & Library Rooms Cafeteria Adminstration Section
PLANT INTRODUCTION & SEED HEALTH LAB.	200	Seed Healh Experiment Bacterial and Viral Inspection Sowing Preparation
PROCESSING BUILDING	230	Pre- Drying, Threshing, cleaning and Preparation Vegetable Seed Preparation Fumigation Fertilizer Pesticide
GREEN HOUSE 6 NUMBERS	1150	Preliminary Evaluation, Multiplication Isolated Cultivation, Multiplication Acclimatization Cultivation Detailed Evaluation
STERILIZED SOIL AND CULTIVATION	60	Incinerator Cultivation
Power Supply	150	Sub-station (Emergency Generator and Power Distribution System).
HGH TANK FOR LIQUID NITROGEN	80	Storage Tank for Liquid Nitrogen With Distribution System
PUMP ROOM HIGH TANK AND WATER SUPPLY FACILITIES	130	Water Distribution
GARAGE AND WORKSHOP	160	
TOTAL FLOOR AREA (INCLUDING 6 GREEN HOUSS)	5270 sq.m	

Gerplasm Resources and Conservation of Biodiversity of North Africa

By
A.Z. EL ABEDIN ABDELSALAM
Faculty of Agriculture
Ain Shams University, Cairo, Egypt.

Introduction

The fact that genetic variability allows populations to adapt to environmental change is valid for all organisms including animals, plants, beneficial insects and microflora where the evolution course is quite variable. The evolutionary process that maintained this diversity in the past is unable to survive in the present technological era. The present abundance of genetic diversity which still survives is being threatened by a combination of population pressure, adverse economic conditions and civil disturbances. The further threat of climatic changes is likely to maximize the interaction among these factors and subsequently further deterioration of genetic resources. The science of genetics in general and precisely conservation genetics should play a sizable part to minimize the effect of these risks.

In Egypt, serious trials are carried out nowadays to establish a National Egyptian Gene Bank "NEGB". One of these trials is a subcontract of UNEP/EEAA (NBU) joint project (GF/6105 - 92 - 02 - 2205) for country study on the status of biological diversity of Egypt. This project is supervised by Prof. M. El Kassas and operated by Prof. E. El Badry.

Furthermore, Egypt is a member of the fifteen countries group. This group decided to establish three regional genebanks, in Africa (Egypt), in Asia (India) and in Latin America (Argentina). This project is carried out by Prof. H. Abdelaziz, Vice President of the Egyptian Academy of Scientific Research and Technology (ASRT). The establishment of such a regional genebank would satisfy the real need for such institution in North Africa

Proposed Mandate of Preservation for Gene Bank

- To preserve and to document the genetic variation of valuable material of economic crops and their wild relatives.
- To maintain the genetic identity and integrity of the material.
- To provide, free or against remuneration, stored material and documentation.
- To take part in the international cooperation regarding genebank activities.

Genebank work ought to be planned for a period of approximately 100 years. A shorter period of time could imply harmful discontinuity of the maintenance of the material. On the other hand it must be left to our descendants to improve the techniques and methods as well as to develop new ones for maintenance, e.g. in vitro storage.

The logical conclusion of this must be that the economical resources needed for maintenance of a sample for 100 years are anticipated when a sample enters the genebank. This means that a genebank which accepts the responsibility for a sample also accepts a financial obligation - which can accumulate to a considerable amount over 100 years. The amount of work and money required will, of course, depend on the type of the biological material.

The proposed 100 year period indicates one of the differences between genebank work and breeding work; in the latter, 15 years would be a more relevant period of time.

However, the main difference is that genebanks preserve genetic diversity. This is quite contrary to the aim of plant breeding which is to obtain genetic homogeneity by utilizing this genetic diversity. Genebank and breeding work therefore, should not be confused or mixed; instead, both should cooperate for mutual benefit.

For material to be accepted by a genebank the following four criteria should be fulfilled: quality, quantity, justification and at least a minimum of information.

For quality and quantity, certain standards can be set up quite easily. For example, the following are acceptable justifications for an accession:

- Collection of indigenous, wild material of a relevant species which is threatened.
- Representative population of indigenous relevant species.
- Local cultivar adapted to a certain area.
- Modern cultivar adapted to a certain area.
- Representative of named gene/allele.
- Representative of named character.
- Representative of named and described mutant.
- Representative of named and described chromosome mutant.
- Isogenic line.

The main objectives of a genebank are:

1. To preserve for posterity genetic resources threatened by extinction.
2. To document genetic resources in general.
3. To serve plant breeding in particular and plant science in general with basic material and information.

Gene pools

Gene pools are populations in which the full range of genetic variation is maintained.

Genetic concept of gene pools

Primary gene pool

- Corresponding to the biological species concept.
- Crossing within the gene pool easy, hybrids generally fertile.
- Chromosome pairing and gene segregation approximately normal.
- Gene transfer generally easy.

Secondary Gene pool

- Approximate and experimentally defined coneno species, includes all biological species crossing with the crop.
- Gene transfer possible after overcoming barriers separating biological species.

Tertiary Gene pool

- Crosses can be made with the crop but hybrids tend to be anomalous, short-lived, or completely sterile.
- gene transfer is either not possible with traditional techniques.
- Or rather extreme or radical measures are required, e.g. embryo culture, grafting, doubling of chromosome number, using bridging species.

Gene pools - different handling

(Agronomic concept)

Modern cultivars ..

Modern farm management standard plant breeding type of observations ex situ preservation.

Landraces

Local environment, farm management of the relevant time period, modified standard plant breeding type of observation, inter situ preservation.

Special collections genetic stock
Modern farm management, very specific, often sophisticated, observations ex situ preservation.

Wild material
Ecological relevant environment, often unknown type of observations, difficult to cultivate and handle, in situ preservation.

Gene pools: (Conservation concept)

Domesticated gene pool
The genetic variation within the domesticated forms of a species.

Wild gene pool
The genetic variation within the wild forms of a species.

Endemic gene pool
The genetic variation within the populations endemic to a certain country or region.

Indigenous gene pool
The genetic variation within the populations indigenous to a certain country or region, i.e. wild growing populations as well as cultivated ones.

Exogenous gene pool
The genetic variation within the populations of species introduced to and adapted to a certain country or region, i.e. no wild growing populations exist.

GENETIC UNITS FOR PRESERVATION IN GENEBANKS

Gene:
The aim must be to preserve all known alleles within a species and to maintain as many as possible of those not yet identified. This is possible with a relatively limited number of accessions.

Gene-blocks:
Ought to be preserved when justified. Such justifications may be adaptive blocks for climatologically or ecologically extreme and/or marginal areas, for high yield under specific circumstances and/or specific quality combinations, etc.

Chromosomes:
Can constitute units for preservation when justified by special value, for example aneuploid lines, translocations or other chromosome changes.

Genotypes:
Ought to be preserved when justified, for example varieties of self-fertilized or vegetatively propagated crops or breeding lines thought to be of particular value as parents.

Groups of genotypes:
Ought to be preserved when justified, for instance varieties of cross-pollinated crops, representatives or relatives of cultivated species.

The genetic unit mentioned above is oriented in a descending order in terms of accuracy or in an ascending order in terms of quantity. It is worthy to mention here that a smaller genetic unit as cistron or even a sequence of nucleotides would be added before genes. It seems that we are going to preserve just sequences of DNA in future.

Samples and collections
It is quite important to have replicates of samples and to have more than one collection as much as we can to avoid the loss of any material. Seed collections are good examples for this statement.

Seed collections

Safety base collection:

The main objective to be a safeguard against any accidental loss of material. Consequently, a limited amount of the most original seed material is kept in place separate from the Base and Active collection, as little accident-prone and as independent of artificial energy supply as possible, in the NEGB permafrost store.

The base collection

The main objective is to keep the material at as high genetic quality as possible. The number of rejuvenations are therefore to be kept at a minimum and the handling of the material to be under strict quality demands. The source of seed of the Active collection. Kept under long-term storage conditions.

The active collection

The main objective is to provide seed for the distribution and material for characterization and other work relevant to genebanks. Consequently multiplication of the material becomes a major undertaking. Kept under long-term storage conditions.

A working collection

Material held by breeders; there is a clear distinction between breeders working collections and the breeding material.

The activities of the proposed genebank

1. Collection of wild species and economic varieties.
2. Classification and evaluation of the collected material using morphological, cytological and biochemical genetic tools.
3. Short term conservation either in vivo or in situ.
4. Long term storage using seed long storage technique and/or cell and tissue culture.
5. Periodical reevaluation of the conserved and stored material to discard mutational events and soma-clonal variations.
6. Following the progressive techniques aiming the in vitro storages of the genic material of certain biological resources to adopt and adapt some of them in the bank routine work.
7. Documentation of the conserved and stored material to form a national data base for the genetic resources of Egypt.
8. Supply the genetic improvement programs carried out by different Egyptian institutes by the required germ plasm.
9. Exchange of genetic resources with foreign institutions.
10. Carry out research projects in the fields related to genebank activities.
11. Organize symposia, training courses and scientific meetings in the scientific fields of conservation biology or conservation genetics.
12. Publish a genetic resources newsletter or other periodicals.

Conservation of the genetic resources

1. Seed storage
2. In situ and ex situ conservation of plant genetic resources (PGR).
3. In situ conservation of animal genetic resources (AGR).
4. Cryopreservation of PGR.
5. Embryo and gametes storage of AGR.
6. Conservation of microbial genetic resources (MGR).

Characterization and evaluation of the concerned genetic resources.

1. Morphological characterization
2. Cytological characterization

3. Genetical evaluation
4. Pre-breeding criteria of PGR & AGR
5. Germination ability tests

Most of genebanks depend on morphological and/or prebreeding criteria for the characterization of the conserved material. Although morphological characters are mostly monogenic traits, they are affected by environmental conditions. Similarly, prebreeding criteria as yield components in plants and reproductive traits in animals are extremely affected by environmental conditions. These characters are mostly quantitative characters, thus the environmental variance is quite high. Considering these criteria only for characterization of the conserved material would cause a misleading. We are quite convinced that biochemical genetic fingerprinting is a good tool for characterization and genetic evaluation of the conserved material. This fingerprinting would be achieved by protein banding pattern and/or isozyme polymorphism. It has been well acknowledged that each electrophoretic band represents a single and separable transcriptionable event. Therefore biochemical genetic fingerprinting satisfies both adequacy and accuracy for the characterization of the conserved material. However, in some cases of closely related lines it would be necessary to proceed to molecular fingerprinting by employing EFLP or any other molecular genetic techniques. In general, it is highly recommended to use biochemical genetic fingerprinting as a routine work and molecular genetic fingerprinting just in cases of necessity.

Medicinal Plants in North Africa: An Endangered Component of Biodiversity

By

K. H. BATANOUNY

Director, Centre for Environmental Research & Studies, Cairo University

Introduction

In view of the diversity of the habitats and the climate of the region, the biota exhibits considerable diversity. The plant resources, despite the climatic aridity, are diverse and some of them could be unexpected food or remedy for humanity. The medicinal plants growing in the various habitats in N. Africa represent a major and important component of the biological diversity in the region. Due to the continuous overexploitation, many species of these plants are threatened and some are on the brink of extinction. The present paper covers an historical review of the knowledge of medicinal plants in the region. It represents an attempt to give an overview of the present status of medicinal plants in the region, their exploitation and constraints of their cultivation and conservation.

Historical Review

Since times immemorial, the use of plants for curing human diseases have been practiced everywhere. Such use of plants is a part of the human history in N. Africa. The people in the region depended mainly on traditional medicine for their health care needs and the ailments of their animals. The folk medicine in the region is full of recipes for curing various diseases. The term "Attar" in Egypt and "Herb's seller" in Tunisia denotes the persons who sell drugs and medicinal plants for curing diseases or for health care.

In Egypt, the famous Ebers Papyrus, written in 1550 B.C., gives 842 prescriptions, that are not explicitly magical, they are made of 328 different ingredients. Among them are plant species growing in Egypt or other N. African countries, e.g. *Artemisia absinthium*, *Acacia* spp., *Balanites aegyptiaca*, *Bryonia* sp., *Hyoscyamus muticus*, *Myrtus communis*, *Onopordon* sp., *Ziziphus* sp., etc.

Dioscorides, in his Materia Medica, gives the names of many plants from Egypt (*Acacia nilotica*, the Egyptian thorn) and Cyrenaica (*Dorema ammoniacum*)

The Muslim herbalists wrote over centuries many books and treatises on medicinal plants in N. Africa. The names of these plants were given in Arabic, Amazighy, Greek, Persian, and other languages.

One of these Moslem Scholars is Ibn El Jazzar al-Quairawani (died 389 Hj., 1005 A.D.) who wrote many books; one of them about simple drugs. This book includes 272 drugs, mainly of plant origin, it has been translated to Greek, Latin and, Hebrew.

Abul-Abbas an-Nabati, Ibn Ar Rumiya (d. 637 Hj. 1239 A.D.) who has been given the title (Botanist), made an excursion in N. Africa, the Levant and Iraq. After his return to Seville in Andalusia, he established a pharmacy for selling drugs and wrote a book entitled: Botanical Journey.

Another famous Muslim Scholar in N. Africa is Ibn El Beitar (died 646 Hj., 1248 A.D.) who wrote the well-known monumental work "*Gamie Al Adwiyah wal-Aghzia*." which has been translated to Latin (in 1758) and other languages. He made an expedition in N. Africa, the Levant and Asia Minor. Ibn El Beitar described 1400 drugs, including 300 not mentioned by Dioscorides and other herbalists before Ibn El Beitar. It is interesting to mention that he gives the names of the plants in different languages, its description, habitat and geographical distribution.

Another Muslim Andalusian Shcolar, al-Ghassani (d. 1019 Hj., 1611 A.D.) innovated a system for the classification of the plants. He described in his book about 380 drugs, mainly of plant origin. He described the plants, their habitats and differentiated between annual and perennial herbs.

In modern ages, publishing the manuscripts of these scholars and others took place. Writing about medicinal plants became common. Institutes, universities and research centres hosted many studies on the medicinal plants of the different countries in N. Africa. Phytochemical screening and search for active principles in wild plants represent common projects in the different countries. Ecological, taxonomical and floristic studies of medicinal plants took place.

In 1960 a book on the medicinal plants in arid zones was published by UNESCO. Later, in 1983, Boulos wrote a book on the medicinal plants in North Africa in which he gives information about these plants and their therapeutic uses in folk medicine. Scientists from the region wrote many books and articles about the medicinal plants (cf. Batanouny 1989, 1994).

Nevertheless, there are gaps of knowledge about the medicinal plants in the region, e.g., their autecology, distribution, productivity, possibility of cultivation. In view of the rapid extensive exploitation of the wild medicinal plants in the region. It is indispensable to undertake studies on these plants and investigate methods and measures of conservation.

Ecogeography of the Region

The North African countries occupy an ecogeographical region representing the southern sector of the Mediterranean Basin. All the five countries of the region comprise a part of the sea to the north, coastal lands that are directly influenced by the maritime environment and an inland part lying within the transitional belt that borders the tropics.

To look to the region as an ecogeographical unit reveals that the different countries have numerous similarities. The environment, biota and culture have no political borders. The similarities comprise: land use as affected by the prevailing dry conditions, traditions as well as language and religion. The culture is among the factors affecting the use of the plants and animals as well as land and water. The human culture of nomadism and shifting cultivation is common in the region.

Despite the occurrence of similarities, the region exhibits considerable diversity as regards its climate and habitats.

The five North African countries occupy an area of some 5 734 050 sq. km; some 446 700 sq. km of this area, or about 77.9% is hyperarid, with limited irregular rainfall. Only 7% (4 240 sq. km) of the area is not a desert and receive an average annual rainfall of 400 mm or more. These are mainly located in Algeria (3%) and Morocco (3.3%).

The irrigated area represents only 0.6% of the area of the region, and the rainfed cropland covers an area of 3.54% of the total area. On the other hand, the total rangelands in the region occupy 17.9% of the total area. It is noteworthy that the desertified area in the irrigated, rainfed cropland and rangeland areas reach 18.5% of the total area of the region. Adding this to the hyperarid area of 77.9% gives a value of 96.39% representing the desertified and waste hyperarid land in the whole region. The ever increasing population in all the countries create a considerable pressure on the natural resources of the region. The population increase is at high rates.

The habitat diversity in the arid zones of the N. African countries is remarkable. The area is characterized by deep depressions cut in the desert reaching more than 100 m below the sea level. On the other hand high mountains rising above 3000 m above sea level occur in different countries of the region. This vertical variation due to considerable differences in height and horizontal variation in the environment from north to south creates a conspicuous diversity in the biota.

The occurrence of long shores along the Red Sea, the Mediterranean Sea and the Atlantic Ocean in

the region results in the presence of vast areas occupied by wetlands. This is increased by the presence of lakes; both coastal and inland, lagoons, estuaries and marshes. These wetlands are habitats for special biota and are essential breeding, rearing and feeding grounds for many species of fish and wildlife.

The Sahara is stippled with a number of oases with artesian water resources. These are featured with their dense palm groves and water springs. They represent a special habitat with particular biota.

The innumerable landforms in the region are evident from the numerous Arabic terms of these landforms, e.g., reg, erg, serir, hamada, etc. Also, there are numerous local and Arabic names given to the different geomorphological features of different soil types, e.g. wadi, or oued, sebkha, sebka, oioun (springs), chotts (dry lakes) gilgai (in Libya, rough channeled and hummocky microrelief), draa (geometrically arranged sand mountains), ghroud (Oghroud) (dunes with pointed peaks). The richness of these terms indicates the awareness of the natives with the naturally occurring phenomena.

The Saharan massifs are prominent features with particular environmental conditions and biota. These include massifs of Hoggar, Tassili des Ajjer, Adrar des Ifoghas, Air, Tibesti, Ennedi and Gebel U'weinat.

The presence of the Nile crossing Egypt from south to north creates a very unique fertile area in the region, the Delta and the Nile Valley. Intensive agricultural activities in this country since millennia have their impact in changing the wildlife in the area. Weeds, aquatic plants, particular birds, rodents and reptiles as well as mammals occur in this area.

Refugial Sites

Alternating wet and dry periods is a feature of the palaeoclimate in the region. Increased aridity brought the isolation of the vegetation on the Saharan massifs. The fascinating isolated fauna on mountain 'islands' in the Sahara are remnants of a wetter period (Warren 1984). The Sahara, with its mosaic of varied, unconnected habitats, such as massifs, jebels, sandy plains seperated by stony hamadas, and isolated oases, is the perfect situation for the evolution of morphological variations as well as ecotypic differentiation in the biota.

It is to be noted that there are refugial sites supporting particular species; *Juniperus phoenicia* in particular mountains in Sinai. Also, *Cupressus dupreziana* A.Camus in a few localities of Tassili des Ajjer is one of the examples of the occurrence of special plants in the refugial sites. Other local enclaves of high mountains are of common occurrence

It seems very important to investigate the biological diversity of these refugial sites. One should notice that the isolation of these refugial sites leads to a certain degree of speciation, especially amongst the Mediterranean element, e.g. *Olea europaea* subsp. *lapperrinei*, *Cupressus dupreziana*, etc., resulting in the flora that we know today (Wickens 19

Wild Medicinal Plants in N. Africa

The conspicuous habitat diversity in the region as a result of geographical, physiographic, edaphic, and climatic conditions, is reflected upon the plant life. thousands of plant species grow wild in the North African countries (Table 1). Doubtless, man has been using hundreds of these species for their therapeutic value or as condiments.

The list of medicinal plants in the region is inexhaustible (cf. Batanouny 1983). There is no complete inventory of medicinal plants of the North African countries. In the present paper, the pharmacoepial medicinal plants will be given separately. Then we shall deal with the common plants used in folk medicine. A list of the endemic plants will be given.

Table 1- Total Plant Species, Endemic and
Threatened Species in the North African Countries

Country	Total Number	Endemic Species	Threatared Species
Egypt	2076	70	98
Libya	1825	134	58
Tunisia	2196	x	26
Algeria	3164	250	147
Morocco	3675	600 - 650	197

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1. Pharmacopaeial Wild Medicinal Plants.

These are plants used in folk medicine since a long time ago. Recent and modern studies on these plants proved the occurrence of active principles in these plants. Their pharmacological activity had been investigated. They are among the pharmacopoeial drugs in different pharmacopoeias; either in the Arab countries or abroad.We shall give a list and some information about some of these plants, which grow in at least one of the five countries of North Africa.

1. Anacyclus pyrethrum (L.) Link

Official : Radix Pyrethri.
Arabic : Oud El Qarh El Maghrabi, Aaqer Qarha, Oud El Attas
English : Pellitory of Spain, Pellitory
French : Pyrèthre, Pyrèthre Salivaire

This plant grows in Morocco and Algeria. Algeria is the main source of plant. The root and the lower parts of the stem constitute the drug. It is used in folk medicine in all the N. African countries and was in the US phaermacopoeia over the period 1820 - 1926.

2. Citrullus colocynthis (L.) Schrader

Arabic : Handhal
English : Colocynth
French : Coloquinte

The fruits, fruit bulb and seeds are used in the folk medicine. The plant is common in all the North African coutries. The fruit bulb is pharmacopoeial

3. Juniperus communis L.

Arabic : Ar'ar
Barber : Tamerbout
English : Juniper tree
French : Genévrier

The plant grows in Algeria and Morocco. However, there are other species growing in different countries of the region, e. g. *J. oxycedrus* L. in N. Africa except Egypt, and *J. phoenicea* L. growing in all

the countries of N. Africa The latter species is considered to be an endangered species in Egypt. It grows in a very limited area on the mountains of N. Sinai; Gabal Halal.

The wood, branches, leaves and berries are used in folk medicine.

4. Senna alexandrina Mill.

(= *Cassia senna* L., *C. lanceolata* Forssk., *C. acutifolia* Del.)

Arabic : Sana makki, Sana
Barber : Agerger
English : Indian Senna
French : Séné

The leaves and pods are the official drug. The drug is used widely in the folk medicine in many countries of the world. It grows wild in Egypt, Libya and Algeria.

5. Senna italica Mill.

(= *Cassia aschrek* Forssk., *C. obovata* Collad., *C. italica* (Mill.) F.W. Andrews)

Arabic : Sana makki, Salamekki, Sana
Barber : Agerger
English : Senna
French : Sénné, Séné de Sénégal

The leaves and pods are used in the same way as Senna alexandrina.
The plant grows in Egypt, Libya and Algeria.

6. Colchicum autumnale L.

Arabic : Khamira, Okna, Lehlah
English : Meadow Saffrom, Autumn Crocus
French : Safran bâtard, Colchique

The corm is the drug used, The species grows in Tunisia, Algeria and Morocco. Other species grow in the different N. African countries. The species has been recorded in Egypt since many decades, but now it is extinct. Generally, it is an endangered species in the other countries due to the deterioration of its habitat and its overcollection.

7. Urginea maritima (L.) Baker

Arabic : Basal Faro'n, Onsul, Basoul, the Red one is Summ El Far.
Barber : Ichkil, this is the Greek name of the plant and was used in the treatises of the Arab herbalists.
English : Squill, Sea Onion
French : Scille maritime, Oignon marin.

The flashy scales of the bulb are used in the folk medicine. They are the official drug.The plant grows in all N. African countries. It is threatened due to the overexploitation. In Egypt, studies of Batanouny and Khalifa (197) shows that the repalacement of the dug bulbs takes many years to reach the same number but not the same weight.

8. Plantago afra L. (=P. psyllium L.)

Arabic : Seeds =Bizr Qatounah
English : Flea Wort
French : Herbe aux pauce, Puciere

The seeds are the official drug. The plant grows in all the N. African countries.
Many species *of Plantago* grow in Egypt (cf. Ahmed et al, 1972) It is to be noted that some *Plantago* species are good forage and range plants.

9. Hyoscyamus muticus L.

Arabic : Sakaran
English : Egyptian Henbane
French : Jusquiame d Egypte

The herb is used in folk medicine. This species grows only in Egypt. It is exported and has a high value. Other species, with the same use in folk medicine grow in the other African countries, e.g. *H. albus* L., *H. faleslez* Coss, and others.

Plants used in Folk Medicine

There are numerous plant species which are collected from the field to be sold in the "Attarin" or the Herb's seller shops.

The great surge of public interest in the use of plants, as well as some animal products, as medicines is based on the assumption that the plants will be available on a continuing basis. However, no concerted effort has been made to ensure this, in the face of the threats posed by increasing demand of vastly increasing human population and extensive destruction of plant rich habitats.

A list of the common examples of wild plants used in the folk medicine in N. Africa is given below. Drugs obtained from these plants are sold in the markets all over the region. Shops selling these drugs, either fresh or dried, are widespread in the main cities of these countries. Usually, these shops are found in the old part of the city. All over the Arab, and also the Islamic Worlds, One finds that these shops are in the old part of the city. These shops occur in narrow lanes and are full of drugs obtained from the same country or imported from different countries. The continuous use of these plants impose a considerable pressure on the naturally growing plants in the deserts and semi - deserts of the region. In such habitats, the rate of exploitation is more than the rate of establishment of new stands of the collected plants. Doubtless, this has consequences affecting the components of the environment, including the biodiversity.

Achillea fragrantissima (Forssk.) Sch.Bip. Arabic: Qaysoum
Recorded in Egypt

Alkanna tinctoria (L.) Tousch. Arabic: Henne Al-Ghoul, Kahla
Recorded in all N. African countries.

Artemisia absinthium L. Arabic: Shajaret Mariam, Afsanteen
Recoreded in Algeria and Morocco

Artemisia herb-alba Asso Arabic: Boaitheran, Shih
Recoreded in all N. African countries.

Artemisia juidaica L. Arabic: Shih
Recoreded only in Egypt.

Berberis hispanica Boiss. & Reuter Arabic: Anbarbaris, Oud El-Rih
Recoreded in Algeria and Morocco

Borago officinalis L. Arabic: Lisan El-Thor
Recoreded in Tunisia, Algeria and Morocco.

Bryonia cretica L. Arabic: Le'ba Murra
It is an endangered species and has not been collected since a long time ago.
Recoreded in Egypt.

Bryonia dioica Jacq. Arabic: Fashira, Dalia beida
Recoreded in Libya, Algeria and Morocco.

Capparis spinosa L. Arabic: Kabar, Lasaf

Recoreded in all N. African countries.

Cuscuta epithymum (L.) L. Arabic: Kashout
Recoreded in Libya, Tunisia, Algeria and Morocco

Daphne gnidium L. Arabic: Lezzaz
Recoreded in Tunisia, Algeria and Morocco

Ecbalium elaterium (L.) A. Rich. Arabic: Faqous El-Homar
Recoreded in Libya, Tunisia, Algeria and Morocco

Ferula communis L. Arabic: Kalkh, Fasoukh
Recoreded in Libya, Tunisia, Algeria and Morocco

Lavandula stoechas L. Arabic: Halhal, Estakhoudes
Recoreded in Tunisia, Algeria and Morocco

Mandragora autumnalis Bertol Arabic: Beid El-Ghoul ,Yabrouh
Recoreded in Tunisia, Algeria and Morocco

Marrubium vulgare L. Arabic: Marriout
Recorded in all N. African countries.

Paeonia coriacea Boiss. Arabic: Fawania, Oud El-Saleeb
Recoreded in Algeria and Morocco

Peganum harmala L. Arabic: Harmal
Recorded in all N. African countries.

Salvadora persica L. Arabic: Arak, Miswak
Recoreded in Egypt, Libya and Algeria.

Smilax aspera L. Arabic: Ushba Roumiya, Zaqresh
Recoreded in Libya, Tunisia, Algeria and Morocco

Teucrium polium L. Arabic: Ja'da
Recorded in all N. African countries.

Thymus capitatus (L.) Hoffmanns. & Link. Arabic: Za'atar.
Recorded in all N. African countries.

Thaspia garganica L. Arabic: Derias
Recoreded in Tunisia, Algeria and Morocco

Endemic Species used in Folk Medicine

Some medicinal plants growing in the region are endemic; some of them are becoming rare and endangered. Among the endemic medicinal plants used in folk medicine, one mentions the following:

Argania spinosa (L.) Skeels Arabic Argan. Endemic to Morocco

Arbutus pavari Pamp. Arabic: Shamry. Endemic to Libya in Gebel Al-Akhdar

Cedrus atlantica (Endl.) Carriere Arabic: Meddad, Erz. Endemic to Algeria and Morocco.

Euphorbia echinus Hook. fil. Arabic: Um Lebina, Daghmous, Zaqqum. Endemic to Morocco.

Euphorbia resinifera Berg. Arabic: Libana Maghrabi. Endemic to Morocco.

Senecio anteuphorbium L. Berber Shbarto. Endemic to Morocco.

Thymus algeriensis Boiss. Reut. Arabic: Djertil. Endemic to North Africa.

Thymus broussonettii Boiss. Arabic: Za'itra. Endemic to Morocco.

Loss Versus Conservation

The above mentioned plants are continuously collected from their habitats. No means have been taken up till now to conserve these wild plants. The disappearance of these plants has an unseen consequence. This is the knowledge of the medicinal healers. The erosion of such important genetic resources and their deterioration are accompanied with the disappearance of knowledge and traditional experience.

There is a great need to provide a framework for the conservation and sustainable use of plants in medicine. Ethnobotanical studies should be encouraged which represent basic studies to help implementing conservation programmes.

The IUCN, in collaboration with the WHO (World Health Organisation) and WWF (Wid Life Fund for Nature) published the "Guidelines on the Conservation of Medicinal plants". Regional cooperation, in view of the common history roots of the use of paticular plant species, is indispensable. Establishment of a network is an important tool to enhance the activities in the different countries. The International Organization, as well as the Regional ones, should support and encourage the work of the individual countries.

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Plant Genetic Resources in the Flora of Arid Lands of The Mediterranean Region

By
Y. BARKOUDAH
University of Damascus, Syria

Preface

Arid lands are areas where precipitation is much less than evaporation, so that plant life is limited by the factor of water deficiency. Usually aridity is measured by special formulas which take into consideration annual precipitation and average temperature of the region. Though there are differences from one area to another according to altitude and continentality, we can say that arid lands in the Middle East are those with an average annual precipitation of 50-200 mm/year under Mediterranean climate and 50-400 mm/year under subtropical climate regime. According to this criterion a great percentage of the East Mediterranean is arid lands.

These arid lands have a great variability in their flora and vegetation due to many factors; some of them are biotic, others are abiotic. The flora comprises more than 5000 different plant species, in spite of the fact that large stretches of these lands are bare deserts hostile to any kind of life.

One of the reasons for this density of species is the unique position of the East Mediterranean which constitutes a meeting area of different phytogeographic regions: The Mediterranean region, the Irano-Turanian region, the Saharo-Sindian region and the Sudano-Deccanian region. Each of these regions has its own flora and vegetation. Besides, there is a large number of biregional and pluriregional species growing in the region. The topographical diversity of the East Mediterranean creates varied ecological conditions within limited areas, which contributes to an abundance of plant species. The suddenness with which the various floras replace each another in the region is striking.

Furthermore, there is the factor of paleo-plant geography. The flora of the region has undergone many changes in its composition since the Tertiary geologic period. Each geologic period has left its elements as relics in suitable niches in the region.

Agriculture, in the course of its long history, has also contributed to an enrichment in plant species. Many segetal and ruderal plant species were introduced unintentionally from remote parts of the world, others have penetrated from adjacent regions after the local vegetation had been devastated by man.

There are more than 15000 plant species and 1000 genera belonging to 500 families in the arid lands of the East Mediterranean countries. The countries of the region are very different one from the other in their flora. Here are some of the prominent features of each country.

Flora of the Countries

Arabian Peninsula:

The number of plant species in the flora of Arabia amounts to more than 2000 species, most of them are concentrated along the southern and western coasts, while the rest of the region harbors scarcely 400 plant species. There are about 90 plant families and over 700 plant genera, half of which are tropical. the most prominent features of the Arabian flora are:

- The majority of plant species are African.
- The high percentage of endemism is almost wholly tropical.
- many Saharan plants reach their northern limits of distribution in Arabia.

Egypt:

The native flora of Egypt comprises about 2200 plant species; the greatest part of them growing in the Mediterranean coastal part of the country, Gabal Elba, Nile Valley and Sinai mountains. This number in comparison with the area of the country is very limited due to climate conditions; the Saharan climate extending to the Mediterranean coast. There are 103 families and 700 genera. The proportion of species to the genera is low (2.15) in comparison with the global proportion (13.6, after Thonner). This points to the marginal conditions of this country in respect to many genera and the lack of accumulation and differentiation centers in the country.

Iraq:

There are more than 1900 plant species in the flora of Iraq. The number of plant families amounts to 95, of which 19 are represented by one genus and one species only. The number of genera is about 620. The characteristic features of the Iraqi flora are:

- The diversity is limited.
- The arboreal flora of Kurdistan forests and stepppe-forest is prominent in comparison with the steppe and deserts of the country.
- There are relics of Hyrcanian origin in North Iraq from previous humid geologic periods.
- many Saharan and tropical species are spread in south Iraq.
- There are many endemics in the tragacanthic vegetation in the higher mountain zones.
- There is a relic Mediterrranean forest in North Iraq.

Palestine and Jordan

The flora of Palestine comprises 718 genera and about 2250 species arranged into 114 families. These figures are rather high compared with the size of the country, especially when we take in consideration that more than half of the country is desert. The reason for that may be attributed to phytogeographic diversity, where three phytogeographic regions meet: The Mediterranean, the Irano-Turanian and the Saharo-Sindian regions. The northward migration of the tropical and Saharan floras along the coastal plain and the Jordan Valley is quite remarkable.

Syria and Lebanon:

The flora comprises 110 families and 870 genera. The important characteristics of the flora are:

- lack of tropical elements.
- Presence of a fairly large number of trees and shrubs that find their southern limit of distribution in the country.
- The presence of a large number of northern (Auxinian) plants as relics of past humid periods.
- The presence of subalpine and alpine mountainous flora.
- A high percentage of endemism (11%).

Turkey:

A rough estimate of the number of species in the flora of Turkey is more than 9000; the number of genera is about 900.

The features of the flora are:

- The presence of giant genera with hundreds of species, so that the country could be considered as a main or secondary center of speciation.
- There are different relics, enclaves, endemisms and disjunctions in the flora of Turkey which raise problems for phytogeographic interpretation.
- Endemism is the highest in the region (25%). The same is true for the number of tree species, especially Rosacaea.
- A rich alpine flora with relations to Cetral Europe and Asia.

EARLY AGRICULTURE

Agriculture in the East Mediterranean region dates back to the epoch of Natufian culture, that is to say approximately 8000 B.C. The beginning of the domestication of plants and animals, which took place at the late Pleistocene geologic period was a momentous event, which changed the relation between man and his environment. This crucial event had an effect on the growth and civilizationn of the human race as well as on its very survival because it happened at a time when natural resources on which he sustained tended to be exhausted.

The advent of man in the East Mediterranean took place in the Early Pleistocene. There is evidence supplied by Steckelis (1966), Haas (1966) and Picard and Baida (1966) that hunters and food gatherers were in the Villefranche period in Jordan Valley. This is documented by stone tools found by the archeologists. The faunal remains of the sites cover more than 80 different species of vertebrates used as food at that time. These vertebrates represent almost all classes of both terrestrial and aquatic. These animals include Hippopotamus, Rhinoceros, Elephants, Pigs, Deer, Giraffes, Antelopes and three species of Horses.

There is no evidence about man vegetal diet in these periods. but there are hunderds of edible plant species in the flora of our region (fresh or after cooking). In the arid and semiarid regions, even the most primitive man must have been impressed by seeing the seedlings of plants after the first rains of autumn. Prehistorians believe that the habitat of early man was timberless or thinly wooded open land. This corresponds with steppe and woody steppe vegetaion with cereals, legumes, pot herbs and other edible plants. The increase of the human population must have exhausted these natural resources, so that not only animals became less abundant, but also edible plants. It is possible that man tried to repair his food losses by propagating the plants which he gathered. Man learned sowing seed and domesticating animals most probably out of need.

Botanists believe that phytogeographic regions as they are today were the same as at the time of the beginning of agriculture. The boundaries of these regions may have been a bit different. The steppe-forest of the southern edge of the Auxinio-Hyrcanian territory may have been forest before. South Egypt, S. Arabia, S. Palestinen and S. Iran were populated by a dry savanna-like vegetation since the Miocene time after the retreat of the Tethys Sea from S. W. Asia. The flora of these parts was much richer in the Pleistocene period than it is today. At present there are only remnants of the past vegetation.

During the Pliocene period, the western part of the Middle East was invaded by Mediterranean vegetation coming from north west. The result was a mesic forest in the north, evergreen maquis and forests in the west and steppe-forest in the Kurdo-Zagros mountains, plus thorny scrub and savanna in the south, fairly large stretches of steppe-forest in the center of the area and huge extents of deserts and steppe in the east.

PLANT GENETIC RESOURCES

The Near East is perhaps one of the most important centers of origin of agriculture defined by Vavilov, Zhukovsky and Harlan. Despite the scarcity of water and cultivable land in these semiarid and arid areas, the region was one of the major food-producing regions of the world for many centuries. Indeed it was termed the granary of the Roman Empire. Today, it supports a human population of 70 million which is increasing at a rate of 3.5% per annum. It has become the largest food-importing region in the developing world.

The Fertile Crescent is one of the nuclear centers of origin of globally important genetic resources. most of the temperate-zone agricultural plants originated and were domesticated and have their wild relatives and land races still growing there. It is an area of megadiversity of important food crops, pasture and range land species. However the area under cultivation of annual and perennial crops and forest is small leaving the bulk of the land as steppe, deserts and semideserts. The land resource is both slemder and fragile and the conservation and maintenance of its biodiversity and productivity is a crucial concern.

The plant genetic resources are being eroded through degradation of natural habitats, intensification of the cultivation of arable lands, the expansion of cultivation into marginal areas and remnants of forests, the replacement of land races by new cultivars and overgrazing of natural pastures and range lands.

The East Mediterrranean area is considered by Vavilov (1926) as including two of the eight centers of origin of cultivated plants. These are the Mediterranean and South West Asian centers. According to Vavilov the region is the home of origin of more than 160 species of cultivated plants. These plants are at the same time still growing wild in our region. In many cases there are other wild related species growing in the area. The cultivated forms dveloped during the history of agriculture many land races and farmer varieties, which are different from one part of the region to the other. The total gene pool of wild species and land races of cultivated plants has a great potential in the flora of the East Mediterranean Region.

Cereals

Wheat:

Modern cultivated wheats can be classified in two collective species: the hexaploid bread wheats Triticum aestivum and the tetraploid durum wheats Triticum compactum. The bread wheat has three genomes (A, B, D); the durum wheat has two genomes (A, B). The parental plants that donated these genomes to the cultivated plants are still growing wild in our region. These are Triticum monococcum, Aegilops speltoides and Aegilops squarrosa. Monococcum and compactum wheats are partly wild and party cultivated. Bread whet is only known as cultivated plant.

Wild Triticum monoccum, Triticum dicoccoides, Triticum urarta, Aegilops speltoides, A. squarrosa and other related species of Aegilops are very variable in the E. Mediterranean.

Barley:

Cultivated barley, both the two-and six-rowed species are derived from one ancestor Hordeum spontaneum, which has its home of origin in S.W. Asia. The establishment of six-rowed mutants was only possible under domestication after the wild mode of dispersal had been altered through cultivation. The center of distribution of Hordeum spontaneum is in the Fertile Crescent belt.
Wild barley is extermely polymorphic both morphologically and ecologically. It grows in primary open herbaceous communities in the steppe forests well as a weed.

Rye:

Vavilov (1926) postulated that cultivated Secale cereale originated from the wild species of the same name. The wild species is distributed from S.W. Asia to Middle Asia. Some authors split this species into six different binomials because of its variability, but this is not justified. The plant may grow in open communities as well as a weed. Usually the weed type is named subspecies segetale. There are all transitional forms between wild and cultivated ryes, probaly as a result of intercrossing.

Zohary distinguishes two collective species in the genus Secale:

1. S. montanum which comprises 4 perennial taxa all growing in primary habitats.
2. S. cereale with 5 annual taxa, 4 of which with brittle rhachis growing as weeds and one with a tough and brittle rhachis growing as weed and also cultivated. The two collective species differ from one another not only morphologically but also genetically. Yet, they are both interconnected by hybridization. There are, however, cytological barriers which retain the two groups independent.

Oats:

The Middle East is not only the main distribution area of annual oats but most probably also the evolution center of the cultigens. The wild annual oats have three chromosome groups:

1. Diploids like Avena ventricosa, Avena pilosa - A. clauda. Avena longiglumis and Avena wiestii - A. hirsuta clusters.
2. Tetraploids like Avena barbata.
3. Hexaploids like Avena sterilis and Avena fatua.

The Middle East supplied the wild stock for the development of cultivated forms and it was also the arena of their domestication.

FOOD LEGUMES:
The Middle East is one of the richest centers of legumes in the northern hemishere. There are more than 2 200 species among them more than 800 species of Astragalus.

In the local flora†† there are many plant species which can be considered as ancestors or close relatives of cultivated legumes.

Peas:
Pisum sativum was nowhere found in a wild state. Of the local species which are close to it we mention Pisum alatior and Pisum syriacum.

Broad Beans:
Vicia faba was never found in the wild state. There are some species which are related to it like Vicia galilea and Vicia narbonensis.

Lentils:
There are five species in the genus Lens; one of them Lens culinaris is cultivated. Cultivated lentils show many varieties in the E. Mediterranean region. The wild species show also much variation and hybridize with the cultivated plants. Our area is at least a secondary variation center of this crop.

Chick Peas:
Cicer arietinum is closely related to Cicer pinnatifidum which grows wild in our area. Other Cicer species are perennial and not close to the chick pea.

Forage and Range Plants

The East Mediterranean region has a wealth of foddeer plants in its flora, which makes it not only the center of origin of some of these plants but also a source of desirable genes for existing varieties and for the supply of new crops. Here are some examples:

Vetches:

The genus Vicia is represented in E. Mediterranean region by about 50 annual species. Seven cultivated species have their origin in this area. There are large clusters of forms of sativa-amphicarpa-cordata subspecies. Other groups like V. dasycarpa-villosa, V. narbonesis-serratifolia and V. pannonica differ scarcely from their respective cultivars. Plitman considers the region as the site of origin of all widely cultivated species of Vicia.

Lathyrus:

There are 35 annual species of Lathyrus native to our area; some of them are very close to the cultivated Lathyrus sativus: e.g. L. marmoratus, L. cicer . Lathyrus ochrus is also very close to the old forms of cultivated Lathyrus.

Trifolium:

Some of wild species of Trifolium are very close to the cultivated clovers. T. repens, T. pratense, T. incarnatum, T. alexandrinum, T. resupinatum, T. hirtum, T. fragiferum, and T. subterraneum. The clovers of the E. Mediterranean are an inexhaustble source of genes and new introductions. There are a few other species which are worth introduction.

Other genera which have supplied cultivars are: Onobrychis, Medicago, Melilotus, Lotus, Trigonella and Ornithopus.

Many cultivated plants of the Graminae originated in our region. The genera Dactylis, Oryzopsis, Phalaris, Andropogon, Lolium, Poa, Festuca, Cenchrus and Lasiurus supplied many cultivated species. The genera Stipa. Stipagrostis, Agropyron, Themeda and Cymbopogon are sources of fodder plants for desert and steppe areas.

Desert shrubs, especially of the genera Atriplex and Salsola are being used for rangeland improvement on an extensive scale in the E. Mediterranean region.

Fruit Trees

The E. Mediterranean region is far from the center of origin of apples, pears, cherries and apricots. Nevertheless, it is a peripheral area of origin and it is the home of some less common fruit trees such as plums, almonds, pistachio and others.

The Pear:

The role of the E. Mediterranean people in the domestication of the pear tree is not clear. There are ten wild species of Pyrus in the Middle East. Some of these species are used as rootstock for grafting cultivated pear on them. Pyrus syriacus is one of them.

Hawthorns:

Crataegus has six different species in the E. Mediterranean region. Those which are components of the Irano-Turanian steppe are large-fruited and have edible fruits. Of these are Crataegus aronia, C. azarolus, C. laciniata and C. heterophylla. The fruits are collected for home use and they are also sold in the market. Of these species only C. azarolus is cultivated.

Almond:

The genus Amygdalus is represented by about 20 different species in the Middle East. A few of these show some relations with the cultivated almond Amygdalus communis. It is sure that cultivated almond has its home in our region, but it is not as common as other wild species. The species has two forms; a bitter -and a sweet- pitted. One of its relatives is the bitter-seeded Amygdalus korschinskii which grows under steppe conditions, especially on the mountains. This species is very polymorphic in our region. It may intercross with the cultivated and the wild Amygdalus communis.

Prunus:

There are eight species of Prunus in the Middle East. Prunus spinosa and P. divaricata are the parents of the hybrid form of the cultivated plum Prunus domestica. Though our region is not the home of origin of the plum tree, these wild relatives grow in the region.

Pistachio:

Seven species of Pistacia grow in the Middle East. Pistachio (Pistacia vera) has its home of origin in Central Asia, but it is cultivated in our area and has many varieties. Since old times man grafted pistachio on wild spices of Pistacia. Pistacia atlantica is widely used for this aim. Other species used as rootstock for pistachio are Pistacia khinjuk and Pistacia palaestina.

Fig Tree:

The common fig tree Ficus carica is both wild and cultivated in the E. Mediterranean. The cultivated form has many varieties in our region. Condit (1947) assumes that caprifig which is indiginous to S. W. Asia is the primitive type of the cultivated fig.

Pomegranate:

According to Vavilov, the home of origin of the pomegranate is S.W. Asia. The pomegranate Punica

granatum has very many varieties in our region.

Carob Tree:

Ceratonia siliqua is cultivated and growing wild in our region. The fruit is edible and used for making syrup in different countries of the region. There are different varieties which are grafted on the wild forms. One finds grafted and wild trees side by side in Yemen as well as in the Mediterranean countries.

Date Palm:

Fischer (1881) found a wild form of Phoenix dactylifera in the coastal plain of S. Iraq and Iran. This was a bush form with unpalatable fruits. The similarity of the finding with Phoenix theophrastii of Greuter from Crete is not clear. Throughout our area, stands of Phoenix dactylifera are encountered in places far from any human dwellings; e.g. Dead Sea, Sinai, Arabia. One may conclude that the home of origin of the date palm is the lower Tigris and Euphrates region.

Other fruit trees which may have originated in our region are:

Pinion pine Pinus pinea which grows wild in Lebanon.

Celtis australis is both cultivated and growing wild. Its fruits are edible and sold in the market.

Olive Tree:

The olive tree Olea europaea has many cultivated varieties in our region. Probably it is of an Afro-Asian tropical origin. The wild variety of olive, var. oleaster is not exclusively E. Mediterranean, but there is evidence that the people of our region were the first to domesticate the olive tree. Its kernels were found in deposits of the Bronze Age around 2000 B.C.

Afforestation Trees and Ornamentals

Many native trees, shrubs and herbs are planted locally and elsewhere. Of the afforestation trees we may mention Platanus orientalis, Pinus halepensis, P. brutia, P. pinea, Cupressus sempervirens, Cedrus libani, Abies cilicia, Ceratonia siliqua, Salix spp., Pistacia atlantica, Rhus coriaria.

The flora of the E. Mediterranean provided the gardens of the world with numerous ornamental plants. Of these we mention:

Achillea spp.
Adonis aleppica
Alcea spp.
Allium spp.
Alnus orientalis
Anemone coronaria
Antirrhinum spp.
Arbutus andrachne
Artemisia arborescens
Arum spp.
Arundo donax
Buxus sempervirens
Cercis siliquastrum
Chrysanthemum coronarium
Cistus spp.
Clematis vitalba
Colutea arborescens
Jasminum officinale
Laurus nobilis
Lavandula stoechas
Ligustrum vulgare
Lilium candidum
Linum spp.
Lonicera spp.
Lupinus spp.
Matthiola spp.
Myosotis spp.
Narcissus tazetta
Nerium oleander
Nigella damascena
Ornithogalum spp.
Pistacia lentiscus
Ranunculus asiaticus
Reseda odorata

Colutea istria
Cotonaster racemiflora
Crocus spp.
Delphinium spp.
Dianthus spp.
Eryngium spp.
Glaucium spp.
Gypsophyla spp.
Hyacinthus orientalis
Hypericum spp.
Iberis odorata
Iris spp.
(Oncocylus Sect.)
Retama raetam
Rhamnus alaternus
Rosa canina
Ruscus aculeatus
Ruta chalepensis
Salvia triloba
Saponaria spp.
Scabiosa spp.
Spiraea spp.
Spartium junceum
Syringa vulgaris
Tamarix spp.
Ulmus spp.
Vaccaria segetalis.

Spices and Condiments

Some species of the flora of our region are used as spices and condiments. Species of the genera Mentha, Foeniculum, Nigella, Pimpinella, Anethum, Coriandrum, Apium, Carum and Origanum are used for this aim.

Wild Relatives Threatened

The wild relatives of cultivated plants as well as all species of the flora of the E. Mediterranean region are threatened by extinction. There is a massive and unprecedented destruction in the region as well as in other parts of the world. There is an extensive clearing of land for farms, roads and settlements and industry. Overgrazing is wide spread everywhere and specially in the dry areas.

How many of the above mentioned plant species is threatened, we do not know. Some wild relatives which survive as weeds may continue to live, like relatives of wheat, barley and Aegilops, but others like relatives of almond, pear, olive and pistachio are surely threatened.

Some are threatened by genetic erosion, or the reduction of their genetic diversity because of the continuous loss of individuals or populations. When the habitat of the species is reduced, outlying populations are mostly eliminated. These populations contain mostly special characteristics like drought resistance or other local stresses. It is difficult to measure genetic erosion of wild relatives. Actually it is hardly done at all.

Conservation of Genetic Resources

The first major gene bank for the conservation of genetic resources of main crops was established in 1920 in St. Petersbourg, Russia, as a result of the exploration activities of the Russian scientist N.I. Vavilov. In the mid fifties U.S.A. and European countries established their own gene banks. FAO and I.B.P.G.R. helped developing countries to have their own gene banks. Today over 60 major gene banks with long or medium-term storage facilities exist all over the world. The number of accessions in each gene bank is in tens of thousands.

In situ conservation of genetic resources means conservation in the natural habitat of the plant. This applies only to the wild relatives of cultivated plants, since only these plants still live in the natural ecosystem without the care of man and his agriculture. When we conserve these wild relatives in their natural environment, we leave them continue their evolution, while when we collect them as seed and preserve them in the gene bank they stop to evolve. To conserve the biodiversity of wild relatives and to give them the chance to continue their evolution we must conserve them in their natural habitat so that thay can evolve in confrontation with all changes of soil and climate and pests and diseases.

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Protected Areas and Conservation of Desert Ecosystems

By
ABDULAZIZ H. ABUZINADA
National Commission for Wildlife Conservation and Development
Kingdom of Saudi Arabia

Introduction

The idea of putting aside land for special protection of its resources is not a new nor a strange concept to the Arab World. Historically there has been a traditional system of resource conservation in Arabia for more than 1400 years. An important feature was through the allocation of special protection or preservation to a specific parcel of land, known as a hima. The hima system continues to this day as a cultural ethnic and has support in Islamic law. The himas are of value to conservation as they represent refuges for indigenous plants and animals. Their importance to ecological research is evident considering they represent a range of areas that have been protected for long periods of time. They furthermore provide indicators of range potential under particular climatic conditions. The fundamental value of the hima system is that it represents a model of customary law relating to land use (Grainger and Llewellyn 1991).

Protected Areas

One has to ask the question why have protected areas? The World Charter for Nature adopted by the General Assembly of the United Nations in 1982, emphasizes that "every form of life is unique, warranting respect regardless of its worth for man", and that it should be protected for its own sake. The moral obligation to conserve biological diversity is compounded by the pragmatic value to people doing so.

IUCN defines biological diversity (biodiversity) as encompassing "all species of plants, animals and micro-organisms and the ecosystems of which they are part". It describes "nature's variety as including both the number and frequency of ecosystems, species or genes in a given assemblage". This diversity is threatened globally by man's activities, and in the arid regions of the Arab world by particularly such actions as overgrazing of terrestrial ecosystems, collecting of fuel wood and from pollution. At the practical level this is destroying the living foundation on which the region depends.

One way in which to protect biodiversity and to support the durability of development is to create an adequate system of biologically representative protected areas. However protected areas should not be an end in themselves, but an integral element in a country's determination to conserve and develop its life support system. this complies with Islamic principles that counsel the use, without abuse, of renewable resources within an overall respect for life.

The Ecosystem Concept
Ecosystems comprise the complex assemblage of living populations and communities of plants, animals and other organisms, that react with each other and with their physical environment as a more or less closed system, which is itself reacting with other such systems. They are perhaps best viewed as a conceptual base for developing and understanding of the principles underlying conservation science, rather than as physical entities capable of very precise delineation. The concept allows an appreciation of the interrelationships between the various biological and physical components of a system and the

vital processes inherent in these relationships, and why disruption of a portion of the system may have far reaching implications for other parts of the system.

Management of a country's renewable resources will be more efficient if it is based on an understanding of the ecological processes involved, but demands national sympathy and respect for their critical role in supporting the life of a nation. For it is the fundamental ecological processes that underpin human prosperity.

The conservation and development of the region's natural ecosystems is involved primarily with arid rangelands systems, and tropical marine systems of high natural productivity. The low inherent productivity of the desert systems has been further depressed by widespread degradation, while the marine systems are in a generally much more satisfactory state of repair, especially in the Red Sea.

Principles of establishment of protected areas

In planning the number and area of protected areas needed, priority should be given to considerations concerning the present state of ecosystems and the degree of species diversity of associated organisms. The nature of the Arabian arid zone is known to be characterized by diversity and considerable gradients of ecological conditions and hence a wide range of ecosystems. One of the major regularities of the arid zone lies in an increase in fauna and flora species diversity from plain (desert) territories to montane ones. Proceeding from this, the first principle of establishing protected areas is formulated as the correspondence principle. According to this, the protected area network density should be proportional to the general diversity of animal and plant organisms.

As is known, rare species are mostly characteristic of ecotones where the background species of adjoining ecosystems (r-strategy species) are weakened and it becomes possible to introduce species that can exist at low density and in low number (K-strategy species). Higher indices of species diversity, of the level of endemism, and number of relict forms are characteristic of more ancient arid ecosystems of the Neogene - Paleogene age. It follows that protected area designing should be guided by the principle of inclusion into their area of narrow-range species and ecosystems (Voronov and Kucheruk, 1976).

Plain desert territories are more homogeneous in terms of the ecological features and exhibit less species diversity. However these areas also have endemic species, and in the ancient plateaus and uplands relic species may occur. The major feature of plains communities is that they contain numerous dominant species of particular value to range and pasture management. These habitats are known for low numbers of species and reduced productivity in the majority of desert provinces. In designing a network of protected areas in plain desert territories, one should be guided by the principle of typicalness of ecosystem protected, striving to provide each region with at least a single protected area.

The efficiency of protected areas in conserving the diversity of living organisms, particularly mammals and birds, largely depends on whether the biological properties of the species under protection, that is the area of home range, breeding and watering sites, seasonal migration pattern are taken into account in establishing the network of protected areas. The protected area should include the sufficient space and food resources to ensure complete reproductive cycles for the animal dwellers. The protected area should be guided by the principle of landscape completeness and sufficient area so that the ecosystems concerned might function normally (Gunin and Neronov, 1985).

The present situation has important implications for conservation of the Arabian Arid Region's ecosystems. Deterioration of the vegetation is leading to vortex of declining ecological productivity. This can progress beyond a series of thresholds over which recovery is difficult and can take many decades, specially as costly intervention is seldom justified by rangeland economics, particularly in an arid environment. The process may be driven by poor land use, but could also become self-perpetuating, particularly if it begins to influence the physical parameters of the environment, such as climate or the structure of local landforms. The serious implications for both agricultural production and nature conservation are self evident and call for a review of national land use policies. The aim should be to halt and, wherever possible, maintaining the policy of enhancing rural productivity and national

self sufficiency. Protection of adequate representative areas of the natural vegetation are a logical early step towards achieving this important objective.

The Present Situation in the Kingdom of Saudi Arabia

The Kingdom of Saudi Arabia realized the importance of nature conservation and through the years followed its basic principles in its agricultural policies. However it also became clear that in order to protect the country's biodiversity it would have to enhance the traditional hima system. The modern version of conservation started with the establishment of the National Commission for Wildlife Conservation and Development (NCWCD).

The NCWCD was established in 1986 by Royal Decree M/22 with its principle mandate the creation of a representative, well maintained system of protected areas, and to develop the renewable resources of the Kingdom of Saudi Arabia to the benefit of all its citizens.

Initially the first part of the mandate received most of the attention. The NCWCD saw it as a basic need to first develop and maintain a representative system of protected areas in the country. This plan builds on the ancient tradition of himas which is still used after hunderds of years for the conservation, allocation and proper use, of renewable resources. By increasing the amount of land under a high level of protection, the NCWCD is involved in a deliberate process to raise the level of the country's biological diversity according to a well considered set of priorities.

The choice of a site to be protected is made only after it qualifies to a set of predetermined norms, as well as unique natural characteristics. Protected areas are sites chosen for the conservation protection of natural resources and where by wise use they represent the best socio-economic advantages. They are used in Saudi Arabia to mitigate the degradation of natural resources, and set examples of how management of resources on a sustainable basis can be beneficial to the environment and the public at large.

In order to evaluate possible sites, a list of parameters had to be developed that would not only take into consideration important ecological aspects, but also those conservation ethics enshrined in the Islamic culture. The initial survey of sites covered the whole Kingdom. Sites were subjected to ecological surveys and measured against the set criteria. An inventory of sites worthy of protection was prepared and submitted for approval. A total of 12 sites, both terrestrial and marine, from the originally identified 100, have so far been approval as protected areas.

It is important to be aware that the long-term goal of the conservation management efforts of NCWCD is sustainable utilization: that is to say the resources are to be conserved and protected, not as an end in itself, but as a means to ensure that they will be available for use, now and in the future. Sustainable use is, in essence, the second phase in NCWCD's conservation time table. This policy leads automatically to the second part of the Royal Decree.

In order to achieve this, NCWCD follows a pragmatic policy, through a process of zonation of its protected areas, to support sustainable utilization and development of the renewable natural resources under its care. An example being zones of controlled grazing within Protected Areas, where Bedouins are allowed to graze livestock. Unfortunately, particularly in the case of wildlife resources, the low densities of current populations mean that use must be restricted. However, in Farasan Island Protected Area, where natural resources have reached levels that permit utilization, NCWCD is in the process of developing a management plan, not only for terrestrial resources but also for marine resources!

The Conservation model of the Kingdom of Saudi Arabia

The following reviews the conservation achievements of NCWCD as measured against the established protected areas in Saudi Arabia, as well as NCWCD's basic philosophy regarding natural resource management.

Structure

The NCWCD has a Board of Directors, chaired by the Second Deputy Prime Minister and consisting of

the Minister of Foreign Affairs, the Minister of the Interior, the Minister of Agriculture and Water, the Governor of Asir Region, the President of the King Abdulaziz City of Sciences and Technology, the President of MEPA (Meteorogical and Environmental Protection Agency) and the Secretary General of NCWCD. The elements of the Commission are the Board of Directors, a Managing Director (the Minister of Foreign Affairs) and an advisory committee to the Managing Director. Administrative operations are divided into financial and administrative affairs, wildlife conservation and research and field studies, each headed by a director general. The NCWCD also operates three wildlife research centres and a marine research centre.

Staff resources

NCWCD employs 319 people of which 163 are rangers. To develop an efficient and capable staff a core of rangers, training receives a lot of attention. Ongoing training of the ranger corps is aimed at improving their ability to observe and report on the type of biological data required by conservation management and research staff, apart from general maintenance activities.

Nature conservation management

Protected areas can serve their purpose if they are managed correctly. The main tasks to be accomplished in a particular protected area are decided on annually. Deciding on management objectives and how to achieve them are done by a system of specialized advisory committees initiated by the Secretary General allowing him to make use of the expertise available to him, in a structured way. The initial objectives motivating the reason for a particular area's protection readily transforms into the initial master and management plans. This set of preliminary management goals, in turn, gives direction to staff on the ground and supports their actions with the enforcement of law. Staff are normally deployed into area as soon as possible, and are briefed as to their responsibilities as this ensures that management is an ongoing, hands-on operation.

Nature conservation research

Until recently, most of NCWCD's research work focused on breeding programmes for endangered species. Successful captive breeding programmes have allowed NCWCD to reintroduce Arabian oryx, idmi and rheem into established protected areas. NCWCD is also involved in a very active avifauna research and monitoring programme. International acclaim has been earned with its houbara conservation programme. Over the past five years the captive breeding of houbara has outgrown its initial difficulties and an ever-increasing number of birds are becoming available for release. Attention is also given to a number of other research projects, all of which have direct bearing on conservation management issues. Apart from NCWCD staff, specialists from Saudi Arabian universities are also involved.

Public awareness programme

NCWCD has launched a public awareness programme in the Kingdom with the production of diverse educational materials, including a weekly television programme. It has produced television documentaries on conservation-related topics while brochures and posters are developed on an ongoing basis. A permanent exhibition on the country's wildlife is housed at a visitor centre, located at NCWCD headquarters in Riyadh. It has a well-stocked library which also houses more than 200 internal reports on various research projects and its own publications on conservation related issues. It also maintains a large audiovisuals library with copies of video and radio cassettes and photographic slides.

CONCLUSION

Notwithstanding the relevance of the ecological approach to the development planning, a common failing, even in ecological orientated planners, is the scant attention frequently given to the so-called human factor. The existence of a human population anywhere presupposes a complex ethnic, social and biological influences and interactions. If these are not understood and adequately accommodated in resource management plans, the consequence could be serious even disatrous. Care should there-

fore be taken to include the human dimension in planning protected areas and the conservation of ecosystems.

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USEFUL PLANTS IN NORTH AFRICA AND ARABIA

By
LOUTFY BOULOS
Department of Botany and Microbiology,
Faculty of Science, Kuwait University

INTRODUCTION

The number of vascular plants known is about 300,000 species of which some 50,000 are in cultivation. According to Vietmeyer in Hinman & Hinman (1992) about 20,000 are edible plants, but throughout the entire human history only about 3,000 species may have been used as food. However, the world's food supply today is dominated by 30 species. Of these top 30, five crops: sugar-care, wheat, rice, maize and potato provide more tonnage than all the rest put together. Moreover, almost none of these 30 crops would grow in arid lands under dry farming without irrigation. Therefore, the need for new crop plants suitable for arid environments to meet the rapidly growing populations and the loss of arable land by desertification is obvious.

In North Africa and Arabia a notable variety of native plants which are naturally adapted to arid environment constitute a good potential for providing germ plasms of many economic plants. Since time immemorial, this region produced food and forage crops besides medicinal herbs, fibre plants, lumber, oils, resins, waxes, dyes, tannins and other products.

Besides native plants, exotic species from habitats with similar environmental conditions may be carefully selected to be introduced as new crops, sand breaks, sand stabilizers, garden ornamentals or landscape trees and shrubs.

CONSERVATION OF USEFUL PLANTS

In North Africa and Arabia, as in most developing countries, the major source of plants used as drugs in traditional medicine is the wild flora. Over-exploitation of these plants from their natural habitats may lead to their scarcity and probably to their extinction.

Medicinal plants are often over collected for sale to drug markets or for processing as medical products.

Similarly over-grazing of range plants by large herds in arid regions also disturbs the habitat and may lead to its destruction.

Suitable conservation measures should be taken against exploitation of native natural resources by the enforcement of law and through education.

CULTIVATION OF MEDICINAL PLANTS

According to Palevitch (1991) the cultivation of medicinal plants allows the production of uniform quality raw material with standardized properties and the breeding of new cultivars with desirable agronomic and chemical traits makes it possible to conserve highly valuable germplasm in seed banks or botanic gardens.

Alok (1991) states that considerable expansion is required in the cultivation of medicinal plants not only to meet the requirements of the health sector and commerce but also to counteract the harmful effects of over-exploitation of species in short supply. He adds: agricultural universities and other

research organizations have a major role to play in establishing and maintaining model medicinal plant gardens, in carrying out research, in serving as reference centers, in providing technical guidance, in laying agronomic practices for farmers and in studying the economics of medicinal plant production. For plants in short supply tissue culture techniques may be used to provide large numbers of plantlets for supply to cultivators while, at the same time, assessing the content of active principles of plants obtained by such means.

Floristic and Ethnobotanical Studies

The flora of Arabia comprises about 3,800 species and that of North Africa about 6,200 species. Some regional and general works are published on the flora of Arabia: Blatter (1916-1936) on Arabia, Schwartz (1939) on Tropical (southern) Arabia, Migahid (1978) and Collenette (1985) on Saudi Arabia, Mandaville (1990) on Eastern Saudi Arabia, Batanouny (1981) on Qatar, Daoud & Al-Rawi (1985) and Al-Rawi (1987) on Kuwait, Boulos (1988) on the weed flora of Kuwait. A flora on the entire Arabian peninsula and Socotra is planned in 5 volumes of which vol. one is expected shortly.

Several basic works appeared on the flora of North Africa. The most important are those on Morocco: Jahandiez & Maire (1931-1934) and Sauvage & Vindt (1962-1963), on Tunisia: Cuénod et al. (1954) and Pottier-Alapetite (1979-1981), on Libya: Ali et al. (1977-1989), on Egypt: Täckholm & Drar (1941-1969) and Täckholm (1974), on North Africa: Maire et al. (1952-1987) and on the Sahara: Ozenda (1977).

Most of these works give information on the uses of plants in their corresponding regions.

Example of other works which deal with useful plants are: Miller & Morris (1988) on the traditional, economic and medicinal plants of Dhofar, southern Oman; Le Floc'h (1983) on ethnobotanical studies on the flora of Tunisia, Boulos (1983) on the medicinal plants of North Africa, Boulos (1985) on useful plants of the Middle East, Boulos (1989) on Egyptian desert plants with promising economic potential.

Database for Useful Plants

Updated information on the useful plants of the entire region is needed. This could be achieved by establishing a data base system. The advantages of having a collective database are:

- to use a standard terminology.
- to use a standard nomenclature of individual species when dealing with different floras and to avoid confusion in dealing with synonyms.
- to get all available data on plant uses, their habitats, consevation and cultivation from different countries or regions under the same species.
- to collect accurate information about the geographical distribution of every species.

Collaboration between the countries of North Africa and Arabia is essential to establish the database. Some preparatory research should be done on regional floras to establish the standards on which the database would be made.

Once the database is ready, additions, corrections and updating of the information would be possible.

Training of young scientists to carry on field work and to enrich the data base with new information is of prime importance to ensure the success of such a project.

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Report on Workshop on Arid Lands Biodiversity in North Africa

Cairo, Egypt - 14 to 16 November 1994

The workshop on Arid Lands Biodiversity in North Africa was held in Cairo, Egypt, from 14 to 16 November 1994. The workshop was organized by IUCN and the National Egyptian IUCN Committee of the Academy of Scientific Research and Technology, in collaboration with the Swiss Development Cooperation (SDC)

The meeting was attended by about 70 participants, representative members and experts of IUCN, of the five North African countries as well as experts from Jordan, Syria and Saudi Arabia. As part of the regional integration, the IUCN Sahel programme was attended by representatives of international organizations: CEDARE, League of Arab States, UNESCO, INCD, USAID and a number of interested staff members of Egyptian Universities and Research Centers as well as the University of Alger.

The objectives of this workshop were:

* to assess the present status of biodiversity conservation in the Arid Lands of North Africa and adjacent territories;
* to investigate the national policies in the field of arid lands biodiversity in the region and the national programmes;
* to identify groups of endemic species on mountains and oases in the desert in need of conservation action;
* to encourage cooperation among the countries of the region through exchange of information, networking, exchange of experts, data banks, etc., and
* to formulate programmes - short and long term - as a measure of conservation and sustainable use of arid lands biodiversity in the region.

The workshop was opened by a welcome address given by Prof. K. Batanouny, President of the IUCN Egyptian National Committee and Chairman of the Workshop. Dr. Batanouny welcomed delegates to this third workshop of IUCN in the North African region, relating to Biodiversity Convention in N. Africa.

Dr. M. A. Abrougui, Regional Councillor for North Africa, on behalf of IUCN, welcomed all participants and wished success to the workshop and expressed the hope to formulate concrete activities.

Following this, Dr. F. Parakatil, Regional Coordinator for IUCN, presented the Director General's greetings to the workshop and hoped it would recommend mechanisms to share regional experiences, resources and knowledge. It is hoped this workshop would lead to the beginning of a regional programme.

The Consul General of Switzerland, representing the Government of Switzerland and the Swiss Development Cooperation (SDC) appreciated the close collaboration with IUCN and IUCN Committee in Egypt in this important workshop. He said that SDC is very happy to further collaborate with IUCN in its efforts to develop programmes in North Africa.

The Minister of Scientific Research and Technology, Dr. V. K. Gouda, also welcomed the participants and offered the Ministry's support in the deliberations and discussions at this important workshop.

The President of the Academy of Scientific Research and Technology Dr. A. Hebeish, made a statement, in which he stressed the importance of the Biodiversity Convention and cooperation with IUCN in the arid lands programme. He wished success for the workshop.

Dr. A. Beltagui, representing Dr. Y. Wali, Vice Prime Minister and Minster of Agriculture and Land Reclamation, conveyed the greetings of Dr. Wali to the participants of the workshop and explained the extensive programmes of the Ministry in the conservation of biodiversity at the genetic and strain level of crop plants, domestic animals, and micro-organisms.

The meeting appointed Dr. S. Ghabbour as the Rapporteur.

Several technical papers on the status of Biodiversity in the arid lands of N. Africa were presented during the first and second days of the workshop. By the end of the second day the workshop agreed on a draft list of issues raised as a result of the disussions. This list was studied carefully on the third day by two working groups. the first working group was concerned with scientific and technical issues while the second was concerned with socio-economic and administrative aspects of biodiversity management.

At the conclusion of the two working groups, the workshop met in plenary and approved the final document of Recommendations.

Summary of Issues Raised

The need for regional cooperation in the field of:

(1) Scientific Technical Issues:

- inventory of biodiversity of plants and animals and organizing expeditions to areas of promising but threatened B. D richness (hot sites).
- conservation principles of biodiversity in nature reserves, biosphere reserves, gene banks, seed banks, etc.
- exchange of information, based on available data banks (e.g. ACSAD).
- establishing a network or a committee of experts on B.D. (e.g. an SSC for N. Africa).
- collection of references and documents.
- survival of cheetah programme.
- conservation and rational management of medicinal plants.
- establishing referral collections.
- training of specialists and technicions at various levels.
- Diffusion information, education, and awareness programmes and publications in and out of school, with special reference to high level decision makers.
- using standardized methodologies for monitoring and conservation of B.D.

(2) Socio-economics and administrative aspects of B.D. management:

- A thorough assessment of the economic value of B.D. in N. Africa arid lands, as well as their societal and environmental values (e.g. to combat desertification and for restoration of ecosystems that have been desertified.
- maximizing the value of B.D. by research and development to find out new sustainable uses and to enhance sustainable uses that are already known, by the application of new and innovative technologies.
- publication of catalogues about technical aspects of B.D.
- promotion of specialized institutions in African countries for management of biodiversity.
- revision of national legislation to conform with convention on B.D.
- participation of NGO's.
- drawing upon the experience of neighbouring countries, particularly in Mashrek countries, in issues of B.D. conservation and utilization.
- control of illegal trade between countries (transfrontier).
- components of regional cooperation must be integrated and coherent and not treated separately.
- establishing the link between the Desertification Control Convention and the Convention on Biodiversity Conservation.

How to set priorities? Which criteria? Urgency or feasibility?

RECOMMENDATIONS

The subject of biodiversity being multifarious and covering a wide range of areas, of scientific and technical nature, on one hand, and touching intimately upon socio-economic and administative aspects, the recommendations of the workshop were conceived so as to be practicable. They were condensed into 6 groups of programme activities. Some of these programmes are easy to implement within a short time, and at moderate cost. The other group concerns projects for the long term, but bases for their implementation should be thought of as early as possible. these projects are:

1- The publication of a regular (quartely?) bulletin to communicate information about biodiversity in the arid lands of N. Africa, including but not exclusive to, latest developments in the field, at a modest cost, hopefully in three languages, Arabic, Enlish, and French, and probably with its publication office in Cairo.
2- Preparation and publication of a tri-lingual glossary of terms used in biodiversity, for common use in N. African countries, in order to use standardized terms, to unify the conceptual background, and to facilitate communication among scientists, with decision-makers, news media, and with the general public.
3- Projects related to capacity building in the area of biodiversity, involving the following activities:
    - a- training of technicians, experts, etc., by the organization of series of training courses, etc.
    - b- publication of books for childern, adult citizens, and decision makers, on significance of biodiversity, its conservation, and its sustainable utilization. Here, the highlighting of the value of the wild flora and fauna in medicine, biotechnology, and environmental health, among others, is recommended.
    - c- preparation of material for T.V., and other means of mass communication, on biodiversity issues.
    - d- evaluation of existing curricula and preparation of proposals for their upgrading in the light of the experience of some Arab countries, notably Saudi Arabia and Tunis.
    - e- preparation of a directory of biodiversity experts and institutions in N. African and Arab Mashrek countries, concerned with and active in biodiversity issues.
    - f- soliciting cooperation of international organizations for the establishment of live museums of natural histories in countries of the region.
    - g- organization of seminars, workshops, etc., on various biodiversity issues in the region.
    - h- stressing the role of women in capacity building operations on the rational use and conservation of biodiversity in the arid lands of N. Africa.
4- Establishment of a data bank of the biodiversity of the flora and fauna of arid lands of N. Africa, and of results of monitoring of changes in it. The data bank should establish:
    - a- Standardization of terminology.
    - b- Establishment (annually?), of a periodical on data, information, and events in biodiversity. Details are to be elaborated and presented separately. (CEDARE could accept to sponsor this project).
5- Strengthening the role of NGO's and their cooperation with governmental institutions.
6- Establishment of links between the Biodiversity and the Desertification Conventins at the operational level. The scope of biodiversity conservation should be widened through in situ measures at the grass roots level, with involvement of the local population. IUCN could help in facilitating integration of biodiversity components in the National Action Programmes to Combat Desertification in African countries where such Programmes are still in preparation. These components should, to the extent possible, meet the socioeconomic needs of the local people. It is recommended that IUCN establish a Working Group on Biodiversity within its Ecology Committee.

In order to activate the implementation of these Recommendations, the participants agreed to propose

the formulation of three concentric committees:

A- An ad hoc follow-up committee, composed of Dr. Batanouny, Dr. Abrougui, and Dr. Haddane,

B- A wider committee for the formulation of detailed programmes, proposals, and projects, based on the above Recommendations. This intermediate committee will be composed as follows:

Country	From Government	From NGO's
Egypt	Dr. Batanouny	Dr. E. Adly
Libya	Dr. Abufayed	Dr. Maghraby
Tunis	Dr. Zamzami	Dr. Abrougui
Algeria	Dr. Kadik	Dr. Sekkal
Morocco	Dept. of Water & Forests	Dr. Haddane
Saudi Arabia	Dr. Al-Johani	—
Jordan	—	Dr. Alia Hartough
Syria	—	Dr. Barkoudah

C- An interim advisory Committee on North African biodiversity (iacnab), composed of the participants of the workshop and other members whose presence will be felt of benefit to the sound implementation of the Recommendations.

WORKSHOP ON ARID LANDS BIODIVERSITY IN NORTH AFRICA

Cairo, Egypt

14 - 16 November 1995

LIST OF PARTICIPANTS

	NAME	ADDRESS	TELEPHONE/FAX
ALGERIA	Zohir SEKKAL	Mouvement Ecologique Algérien (MEA) 17 rue Shakespeare B.P 203 16070 Alger	Tel: + 213 2 604 650 Fax: + 213 2 606 382
EGYPT	Kamal BATANOUNY President, National Committee Mohammed KASSAS Former-President of IUCN	Department of Botany Faculty of Science University of Cairo Giza 12613	Tel: + 202 3373519 Fax: +202 5676648
	Kamal SABET Chief Technical Advisor	CEDARE - Centre for Environment and Development of Arab Region & Europe 21/23 Giza St. Nile Tower Bldg, 13th floor P O Box 52 Orman Giza	Tel: + 202 570 1859 Fax: + 202 570 5242
	Hamdy A. MOURSY Vice President	Academy of Scientific Research and Technology Dept of Scientific Societies and International Unions 101 Kasr. El-Aini Street Cairo 11516	Tel: + 202 354 1044 Fax: + 202 356 2820
	Esam A. EL BADRY Director	National Biodiversity Unit c/o Egyptian Environmental Affairs Agency 23 A Ismaeil Mohamed St., Zamalek Cairo	Tel: + 202 340 64777 Fax: + 202 340 5962
	Mamdouh RIAD Under Secretay of Afforestation	Ministry of Agriculture Dokki Cairo	Tel: + 202 703 790 Fax: 202 714 98
	Magdy A MADKOUR Director A. ABOU-ZEID	Agricultural Genetic Engineering Research Institute AGERI, Agric Research Center 9 Gamaa Street Giza 12619	Tel: + 202 572 7831 Fax: + 202 629 519
	A. ZEIN EL ABEDIN	Faculty of Agriculture Ain Shams University	

	A. EL-ELSAWI	National Institute of Oceanography Academy of Scientific Research and Technology	
	M.N. MAGDOUB	MIRCEN P O Box 68 Hadayek Shoubra 11241 Cairo	Tel: + 202 220 1603 Fax: + 202 221 4461
	A. MAHER ALI	Assiut University P O Box 318 Dokki, Gizah	Tel: + 202 703 988 Fax: + 202 346 2029
	Samir I. GHABBOUR	Dept of Natural Resources Institute of African Res. & Studies, Cairo University	Tel: + 202 392 4804 Fax: + 202 573 1913
	L. BOULOS	Faculty of Science Kuwait University Kuwait	
	Mostafa A. SALEH	Department of Zoology Faculty of Science Al Azhar University Nasr City Cairo	Tel: + 202 299 1223
LIBYA	A.A. ABUFAYED Director	Technical Centtre for Environment Protection (TCEP) P.O.Box 83618 Tripoli	Tel: + 218 21 48452 Fax: + 218 21 38098
MOROCCO	Brahim HADDANE	Parc Zoologique Nationale de Rabat B.P. 4142 12000 Temara	Tel: + 212 7 741 259 Fax: + 212 7 799 131
	Mohammed HAMMOUMI	Association Marocaine pour la Protection de l'Environnement (ASMAPE) Boîte Postale 6331 Rabat Instituts	Tel: + 212 7 772 988 Fax: + 212 7 799 131
	Mohammed NOURI	Direction des Eaux et Forêts Rabat	Tel: + 212 7 670 072 Fax: + 212 7 764 446
	Ahmed AGBANI	Société Protectrice des Animaux (SPA/SPANA) 41 Lotissement Zohra El Harhoura 12000 Temara	Tel: + 212 7 747 209 Fax: + 212 7 747 493
TUNISIA	Mohamed Ali ABROUGUI	Association Tunisienne pour la Protection de la Nature et de l'Environnement 12, rue Tantaoui, El Jawhari Tunis 1005	Tel: + 216 1 288 141 Fax: + 216 1 797 295

	Name	Address	Tel/Fax
	Jilani ZEMZEMI Noureddine NASR	Secrétariat d'Etat à la Recherche Scientifique et de la Technologie Institut des Régions Arides 4119 Medenine Tunis	Fax: + 216 5 640 435
JORDAN	Alia HATOUGH-BOURAN	University of Jordan Dept of Biological Sciences Amman	Tel: + 962 6 843 555 Fax: + 962 6 832 318
S. ARABIA	Awadh AL-JOHANY Senior Specialist Advisor	National Commission for Wildlife Conservation and Development (NCWCD) P.O.Box 61681 Riyadh 11575	Tel: + 966 1 441 8700 Fax + 966 1 441 0797
SYRIA	Youssef BARKOUDAH	c/o Arab Centre for the Studies of Arid Zones and Dry Lands (ACSAD) P.O.Box 2440 Damascus	Tel: + 963 11 755 713 Fax: + 963 11 755 712
	Souleymane ZEBA IUCN Burkina Faso	c/o IUCN Country Office Burkina Faso 01 BP 3133 Ouagadougou 01 Burkina Faso	Tel: + 226 362 119 Fax: + 226 301 351
IUCN	Simon LININGTON SSC Advisor	c/o Royal Botanic Garden, KEW Wakehurst Place Ardingly nr. Hayward's Heath W. Sussex RH17 6TN United Kingdom	Tel: + 44 81 332 5075 Fax: + 44 81 892 701
	Francais PARAKATIL West Asia/N.Africa Area Coordinator	IUCN - World Headquarters Rue Mauverney 28 CH-1196 Gland Switzerland	Tel: + 41 22 999 0204 Fax: + 41 22 999 0020
SDC	André BISAZ SDC	Swiss Development Cooperation Eigerstrasse 73 CH-3003 Bern Switzerland	Tel: + 41 31 322 3331 Fax: +41 31 325 9363
INCD	Grégoire de KALBERMATTEN Coordinator for Policy and Programme Development	Secrétariat de la Convention sur la Désertification 11 Chemin des Anémones B.P. 76 Ch-1219 Châtelaine Switzerland	Tel: + 41 22 979 9416 Fax: + 41 22 979 9031

ALECSO	Fatma EL MALLAH Director Environment Dept	League of Arab States Cairo Egypt	Tel: + 202 752 966 Fax: + 202 574 0331
KEW	Frances COOK	Royal Botanic Gardens, KEW Ardingly Nr Haywards Heath West Sussex RH17 6 GN United Kingdom	Tel: +44 81 332 5075 Fax: + 44 81 892 701
UNESCO	Abdin SALIH ROSTAS Programme Specialist in Hydrology and Ecology Hani HELAL National Programme Officer in Earth Science	United Nations Educational Scientific & Cultural Organization (UNESCO) Regional Office of Science & Technology for the Arab States 8 Abdel Rahman Fahmy St. Garden City Cairo Egypt	Tel: + 202 354 3036 Fax: + 202 354 5599

INVITED GUSTES

ABDEL SAMIE Ahmed Gamal	National Research Centre Cairo - Egypt	Tel: + 202 346 44 84
ABDEL REHIM Mohamed	Consultant, the Zoological Gardens Giza - Egypt	Tel: + 202 572 62 33 Fax: + 202 572 76 12
ABOUL MAHASSEN Mamdouh	Faculty of Agriculture Zagazig University, Egypt	
AHMED Monir Mohamed A.	Department of Botany, Faculty of Science Cairo University, Cairo Egypt	Tel: + 202 274 10 08
ALLAM Yousria Ahmed, Mrs.	National Research Centre Dokki, Cairo - Egypt	
BATANOUNY Mohiey	Coordinator, NARP (National Agric. Res. Projects) Cairo - Egypt	Tel: + 202 572 85 65 Fax: + 202 629 519
DELGADO David	Agric. Officer, USAID/Cairo Cairo Center, Kasr El Aini street Garden-City, Cairo, Egypt	Tel: + 2020 357 21 32
ELHADIDI Mohamed Nabil	Botany Department Faculty of Science Cairo University, Egypt	Tel: + 202 290 00 90

Thérèse GERNIGON etnseignante	Université des Sciences et de la Technologie d'Alger - Institut de Biologie Alger Algérie	Fax: + 213 2 64 0682
HAMDI Hassan Mahmoud	Faculty of Agriculture Ain Shams University 18, St. 5 - Maadi Cairo - Egypt	Tel: + 202 350 48 35
HAMMOUDA Mahmoud Samy	Faculty of Science Cairo University, Egypt	Tel: + 202 346 80 26
JOUBERT Eugene	Senior IUCN Consultant N.C.W.C.D, P.O.Box 61681, Riyadh (11575) Kingdom of Saudi Arabia	Tel: + 966 1 441 87 00 Fax: + 966 1 441 07 97
KHALIFA Sayed Farag	Department of Botany Faculty of Science, Ain Shams University,	Tel: + 202 244 10 68 Fax: + 202 822 284
LEWIS Lowell	Int. Programs/USAID 4, Gezira El Wusta St., Zamalek Cairo - Egypt	Tel: + 202 340 77 15
RAGI Mohamed	National Research Centre Dokki, Cairo - Egypt	Tel: + 202 848 362 Fax: + 202 700 931
YACOUB M. El-Barasi	Botany Department, Faculty of Science Cairo University	Tel: + 202 298 82 09
ZAYED Kamal M.	Faculty of Science Cairo University, Cairo - Egypt	Tel: + 202 570 23 75

جمهورية مصر العربية
أكاديمية البحث العلمى والتكنولوجيا

أعمال
ندوة التنوع البيولوجى فى المناطق الجافة فى شمال أفريقيا

القاهرة ١٤-١٦ نوفمبر ١٩٩٤

المحرران العلميان

أ.د. كمال الدين حسن البتانونى
كلية العلوم - جامعة القاهرة
رئيس اللجنة القومية لصون الطبيعة والموارد الطبيعية

أ.د. سمير إبراهيم غبور
معهد البحوث والدراسات الأفريقية-جامعة القاهرة
مقرر اللجنة القومية لصون الطبيعة والموارد الطبيعية

الإتحاد الدولى لصون الطبيعة
اللجنة القومية لصون الطبيعة والموارد الطبيعية
أكاديمية البحث العلمى والتكنولوجيا
بمعاونة هيئة التعاون السويسرى للتنمية
القاهرة
١٩٩٦

الناشر
أكاديمية البحث العلمى والتكنولوجيا
القاهرة ١٩٩٦

رقم الإيداع: ٩٦/١٠٠٤٢
الترقيم الدولى: ٧-٥٦-٥٠٣١-٩٧٧

القسم العربى

البرامج الوطنية فى تونس لمقاومة التصحر

الجيلانى زمزمى

معهد المناطق القاحلة - مدنين - الجمهورية التونسية

١ - المقدمة

يعتبر التصحر من المشاكل التى تواجهها عدة دول من العالم ومن ضمنها تونس وذلك نظراً لموقعها المتاخم للصحراء من ناحية ومناخها المتوسطى من ناحية أخرى.

فبالتثبت فى خارطة الجمهورية التونسية نرى أن أكثر من ٣/٤ البلاد لا يتعدى معدل الأمطار فيها ٣٥٠ مم وبالتالى تعرف بالمناطق شبه الجافة والجافة والصحراوية.

أما التصحر فقد أعطيت له تعريفات عديدة لعل من أشملها أن التصحر هو نهاية المطاف لجملة من مراحل التدهور التى تطرأ على الأرض تبدأ بتقلص غطائها النباتى وتنتهى بتفككها وفقدانها لخصوبتها وعدم قدرتها على الإنتاج.

كما أن التصحر ليس بالضرورة توسع الصحراء بظهور الكثبان الرملية ،إنما نتيجة تفاعل عدة عوامل بيئية يلعب الإنسان فيها دوراً رئيسياً ويشكل المناخ عاملاً مساعداً.

٢- أشكال التصحر

يمكن للتصحر أن يكون متعدد الأشكال وذلك حسب العامل الذى لعب دوراً رئيسياً فى ظهوره.

٢. ١ - الانجراف الهوائى او الانجراد

يعتبر تراكم الرمال من أكثر الأدلة على التصحر. كما أن التعرية أو الانجراف الريحى ينتج عليه انخفاض أو انعدام الإنتاج فى منطقتين على حد السواء: منطقة التعرية التى تفقد الجزء الأعلى من التربة الذى يعتبر الجزء الغنى. ومنطقة تكدس أو ترسب الرمال التى تغمر فيها هذه الأخيرة الزراعات فتؤدى إلى موتها، وتظهر تبعاً لذلك كثبان تتخذ عدة أشكال منها النبكة (Nebkas) أو ذات ذيل أو كثيب هلالى (برخان Barchan) إلى غير ذلك.

٢. ٢- الانجراف بواسطة الماء

هى عملية نقل التربة بواسطة الماء وذلك حسب الانحدار ونوع الأراضى واستعمالها ومقدار وشدة الأمطار.

٢. ٣- تدهور الغطاء النباتي للتربة

يتدهور الغطاء النباتي للتربة ويمكن أن ينقرض تماماً لعدة أسباب يكون عادة وراءها:

- الاحتطاب واقتلاع النباتات: ساهم الإنسان فى الجنوب التونسى بقسط وافر فى انجراف التربة بقلع عدة نباتات لاستعمالها كحطب وقود أو لتصنيعها كالحلفاء مثلاً.

كما يساهم بتجميع النباتات الحولية لصنع القرط (الخرطان) واقتلاع الحبوب بعروقها عند الحصاد فى تعرية التربة وجعلها عرضة للانجراف الهوائي.

- الرعى الجائر والناتج عن اختلال التوازن بين متطلبات الحيوانات الغذائية والقدرات الإنتاجية للمراعى وهو خلل ناتج عن تزايد عدد الحيوانات أو عن تقلص المساحات الرعوية بفعل انتشار الزراعات. ومن مضاعفات الرعى الجائر إضافة إلى ما يسببه من ندرة أو حتى اختفاء النباتات الرعوية الجيدة وتكاثر النباتات غير المستساغة تأثيره على مدى إنتاجية النباتات وعلى مدى مقاومتها للجفاف. كل ذلك يحدث فى الوقت الذى يتناقص فيه سمك التربة تحت تأثير عوامل الانجراف المختلفة، فيتقلص الغطاء النباتى وتتدنى إنتاجية النباتات.

- انتشار الزراعات مع اعتماد تقنيات وأساليب إدارة غير ملائمة فى كثير من الأحيان: لا أحد يشك فى ما تشهده المناطق الجافة من توسع سريع فى المساحات المزروعة والمغروسة بالزياتين وذلك باستعمال الجرار كأسرع وسيلة ومحراثه متعدد الأقراص (Polydisques) كأداة للحراثة، أما التقنيات المتبعة بالنسبة للزياتين فهى ما يعرف لدى الجميع بـ Dry farming والتى تتمثل فى القضاء على أى نباتات قد تنمو بين الغراسات بواسطة عمليات الحراثة المتكررة لتمكين الغراسات من استغلال كل الرطوبة المتوفرة فى التربة وللحد من عملية التبخر وهى طريقة لا يمكن التشكيك فى إيجابيتها من هذه الناحية غير أننا أصبحنا ندرك البعض من مساوئها على الأقل فى بعض المناطق حيث تأكد أن محراث الجرار يساهم فى تفتيت التربة وهو ما يعرضها إلى تأثير الرياح خاصة إذا تمت الحراثة بعد أن تصل التربة إلى درجة متقدمة من الجفاف والنتيجة المعروفة لكل هذا هو ظهور الكثبان الرملية أو تعرية أصول الزياتين فى كثير من المواقع.

٢. ٤- تملح الأراضى

يؤدى الاستزراع المكثف للأراضى وريّها بمياه غير عذبة إلى تملحها وبالتالى تصحرها وتظهر عادة فى الأراضى المالحة أنواع نباتية منتقاة طبيعياً لصبرها على مقاومة الملوحة، لكن عديمة الجدوى للإنسان. ويساهم استعمال المياه غير العذبة فى ضياع كثير من الأراضى لأن استصلاحها يتطلب اعتمادات إضافية لصرف المياه.

٢. ٥- الحرائق

تؤدى حرائق الغابات فى المناطق شبه القاحلة إلى نفس النتيجة، إذ يتطلب تعويض الغابات وقتاً وظروفاً مناخية لا تتوفر دائماً.

٢. ٦- الزحف العمرانى على الأراضى الفلاحية

كما توسع مفهوم التصحر فى السنين الأخيرة من زحف الرمال إلى مفهوم أشمل ألا هو تناقص قدرة الإنتاج البيولوجى للأرض أو تدهورها، فقد اعتبرت الأراضى التى تخرج من الدورة الإنتاجية بسبب التوسع العمرانى والصناعى أراض متصحرة.

٣- الخطة الوطنية للمقاومة

تعتمد الخطة الوطنية لمقاومة التصحر على استعمال التقنيات لاستصلاح ما تدهور أو المحافظة على ما هو فى حالة جيدة من ناحية وتعبئة الموارد الطبيعية من ناحية أخرى.

كما أن دراسات المخزونات التقنية القديمة التى عاشت فى الوسط الصحراوى تشكل أهمية بالنسبة لاستنباط طرق التصرف مع هذا النوع من المحيط. ولقد بيّنت هذه الدراسات أن طرق الإنتاج من طرف مواطن الجنوب التونسى الذى بحكم تواجده كسب خبرة فى التعامل مع وسطه الهش وتعتبر مرجعاً للمهتمين بمقاومة التصحر بمختلف أشكاله.

فالترحال مثلاً يشكل نمطاً من العيش يحافظ به الإنسان على محيطه، فبتنقله من مكان إلى آخر بغية الرعى والحراثة يخفف الضغط على الأماكن الأخرى ويمكّنها من استرجاع خصوبتها.

كما إن إقامة الطوابى والجسور الترابية من أهم التقنيات التى استعملت وتستعمل حالياً بعد تطويرها والتى تميز الفلاحة بالمنحدرات بالمناطق الجافة التونسية.

أما المساحات المغروسة والمزروعة فقد كانت الحراثة وخدمة الأرض ممكنة باستعمال آلات تحافظ على تماسك التربة (المحشة والمحراث).

كل هذه التقنيات المستعملة عند المجتمعات القديمة تشكل برامج بحث معهد المناطق القاحلة بمدنين للتعرف على هذا المخزون من ناحية والسعى إلى تطويره لمواكبة العصر.

مقومات الخطة الوطنية

تعتمد الخطة الوطنية لمقاومة التصحر وتعبئة الموارد الطبيعية التى انطلقت منذ ١٩٩٠ وإلى غاية عام ٢٠٠٠ وباعتماد قدر بـ ١٦٤٠ مليون دينار:

- حماية المياه والتربة
- مقاومة زحف الرمال
- التشجير الغابى
- استصلاح المراعى

٣. ١ - المحافظة على المياه والتربة

- تعهد وإصلاح مليون هك من المنشآت المنجزة سابقاً.
- تهيئة ٦٠٠ ألف هك من المنحدرات وسفوح الجبال.
- حماية ٤٠٠ ألف هكتار من الأراضى الزراعية من الانجراف
- تعبئة واستغلال مياه السيلان بإحداث ١٠٠٠ بحيرة جبلية بالشمال التونسى وإنشاء ٢٠٠٠ وحدة لتوزيع مياه الأودية وبناء ٢٠٠٠ "سد" حجرى لتغذية الموائد الجوفية.

٣. ٢- مقاومة زحف الرمال

- حماية عامة من زحف الرمال بغراسة الأشجار الغابية وإنشاء الطوابى لحماية القرى.
- حماية خاصة للواحات الصحراوية بإنشاء ١٠٠٠ كلم من الطوابى وتثبيت ١٥٠٠٠ هكتار للكثبان الرملية بتشجيرها.

٣. ٣- الغراسات الغابية

- إحداث ٣٠٠ ألف هكتار من الغابات
- إنشاء ما يعادل ٢٠ ألف هكتاراً من الأشجار الغابية لحماية الطرقات

٤- استصلاح المراعي

تعتمد الخطة على:

- إحداث ٦٠٠ ألف هكتار من المخزون العلفي عن طريق الشجيرات العلفية منها ٤٠٠ ألف هكتار في الأراضي المشتركة و٢٠٠ ألف في الأراضي الخاصة.
- استصلاح عن طريق الحماية والاستزراع إن لزم الأمر ٢.٢ مليون هكتار من المراعي منها ١.٢ مليون هكتار في الأراضي المشتركة ومليون في الأراضي الخاصة.

أما عن مردودية هذه الخطة فبالإضافة إلى المحافظة على البيئة وهو الهدف الرئيسي يمكن أن يكون لها إنتاج ينعكس خاصة على دخل مواطني الجهة الذي يتلخص في:

- زيادة إنتاج الزراعات الكبرى بمعدل ٤٠٠ كلغ للهكتار الواحد في السنة.
- تعبئة ٥٠ مليون متر مكعب من مياه السيلان.
- حماية السدود.
- إنتاج ما بين ١٢٠ ألف إلى ٥٠٠ ألف متر مكعب من الخشب في السنة.
- إنتاج ما يقارب ٢٠٠ ألف متر مكعب من حطب الوقود.
- زيادة بـ ٦٠٠ مليون وحدة علفية في السنة.
- تشغيل ١٤٦ ألف عامل في السنة لمدة عشر سنوات.

مشروع ثبت بالمصطلحات المستخدمة
فى التنوع البيولوجى
للدكتور إبراهيم حدان (المغرب)

PROJET DE LEXIQUE DES TERMES UTILISES EN BIODIVERSITE
Par Dr. Ibrahim Haddane (Maroc)

ENGLISH اللغة الإنجليزية	FRANCAIS اللغة الفرنسية	ARABE اللغة العربية
Accession	Accession	بلوغ - وصول
Alien species	Espèce introduite	نوع غريب
Assemblage	Assemblage	جمع - تجمع
Biodiversity	Biodiversité	تنوع بيولوجى - تباين بيولوجى
Biogeography	Biogéographie	جغرافيا حيوية - أحيائية
Biological resources	Ressources biologiques	ثروات بيولوجية - موارد أحيائية
Biome	Biome	حيوم
Bioregion	Biorégion	منطقة أحيائية
Biotechnology	Biotechnologie	تقنية أحيائية
Biotic	Biotique	حياتى - حيوى - أحيائى
Buffer zone	Zone tampon	منطقة مصدّة
Carrying capacity	Capacité de charge	حمولة - سعة
Climax community	Climax	مجموعة الأوج - القمة
Comanagement	Comanagement	تدبير مشترك
Common property resources management	Gestion des ressources des terres communales	تدبير ثروات (موارد) الأراضى الجماعية المشتركة (الأراضى المشاع)
Community	Communauté	جماعة - مجمع - آهلة - عشيرة
Comparative advantage	Avantage comparatif	فائدة نسبية - ميزة نسبية
Conservation	Conservation	محافظة - الحفاظ - الصون - الصيانة
Conservation of biodiversity	Conservation de la biodiversité	محافظة على التنوع البيولوجى - صيانة التنوع البيولوجي
Cultivar	Cultivar	صنف زراعى
Cultural diversity	Diversité culturelle	اختلاف حضارى - ثقافى
Ecosystem	Ecosystème	منظومة بيئية - نظام بيئى
Ecotourism	Ecotourisme	سياحة بيئية
Endemic	Endémique	قبسى - متفرد - متوطن
Ex situ conservation	Conservation ex situ	محافظة خارج البيئة الأصلية (صيانة)
Fauna	Faune	وحيش - فونا
Flora	Flore	نبيت - فلورا
Gene	Gène	جينة - موورثة
Gene bank	Banque des gènes	بنك الجينات

Genetic diversity	Diverité génétique	تنوع وراثى - تباين
Germoplasm	Germoplasme	أثلة وراثية
Grassroots	Populistes	قاعدية - شعبية
Habitat	Habitat	موطن - موئل
Hybridization	Hybridation	تهجين - تنغيل
In situ conservation	Conservation in situ	محافظة داخل البيئة الأصلية (صيانة)
Indicator species	Indicateur écologique	نوع دال - دليلى
Indigenous people	Indigènes	أهالى
Intellectual property right	Droit d'Auteur	حقوق المؤلف
Introduced species	Espèce introduite	نوع دخيل
Keystone species	Espèce clé	نوع رئيسى
National income accounts	Revenu national brut	حسابات الناتج الوطنى الخام - الدخل (الإجمالى)
Native species	Espèce d'origine	وطنى - نوع أصلى - نوع بلدى
Nitrogen fixation	Fixation de l'Azote	تثبيت الأزوت
Non governmental organisations	Organisations non gouvernementales	منظمات غير حكومية
Parataxonomists	Parataxonomistes	مُصنفون مُساعدون
Patent	Patente	رخصة
Pathogen	Pathogène	واصم - مُمرض
Phylogenetic	Phylogénétique	نسالى
Phylum	Phylum	عرق - قبيلة
Population	Population	مجموعة - آهلة - عشيرة
Primary forest	Forêt vierge	غابة عذراء - بكر
Primary productivity	Productivité primaire	إنتاجية أولية
Protected area	Zone protégée	منطقة محمية
Recalcitrant seed	Semence recalcitrante	رُشيم مُقاوم - تقاوى عسيرة الإنبات
Rehabilitation	Rehabilitation	إعادة تأهيل
Restoration	Restoration	إعادة - إحياء
Seed bank	Banque des semences	بنك رُشيعات (تقاوى) بنك بذور
Selection	Selection	اصطفاء - انتقاء
Species	Espèce	نوع
Species richness	Richesse en espèces	تنوع - غنى الأنواع - الثراء النوعى
Subspecies	Sous-espèce	نُويْع - نوع فرعى - تحتنوع
Succession	Succession	تعاقب
Sustainable development	Developpement continu	تنمية مستدامة - متواصلة
Systematics	Systématique	تصنيف
Taxon	Taxon	وحدة تصنيف - تقسيم
Taxonomy	Taxonomie	صنافة - تقسيم - تصنيف
Trophic level	Niveau Trophique	مستوى غذائى - اغتذائى
Variety	Variété	صنف